SAE JOURNAL

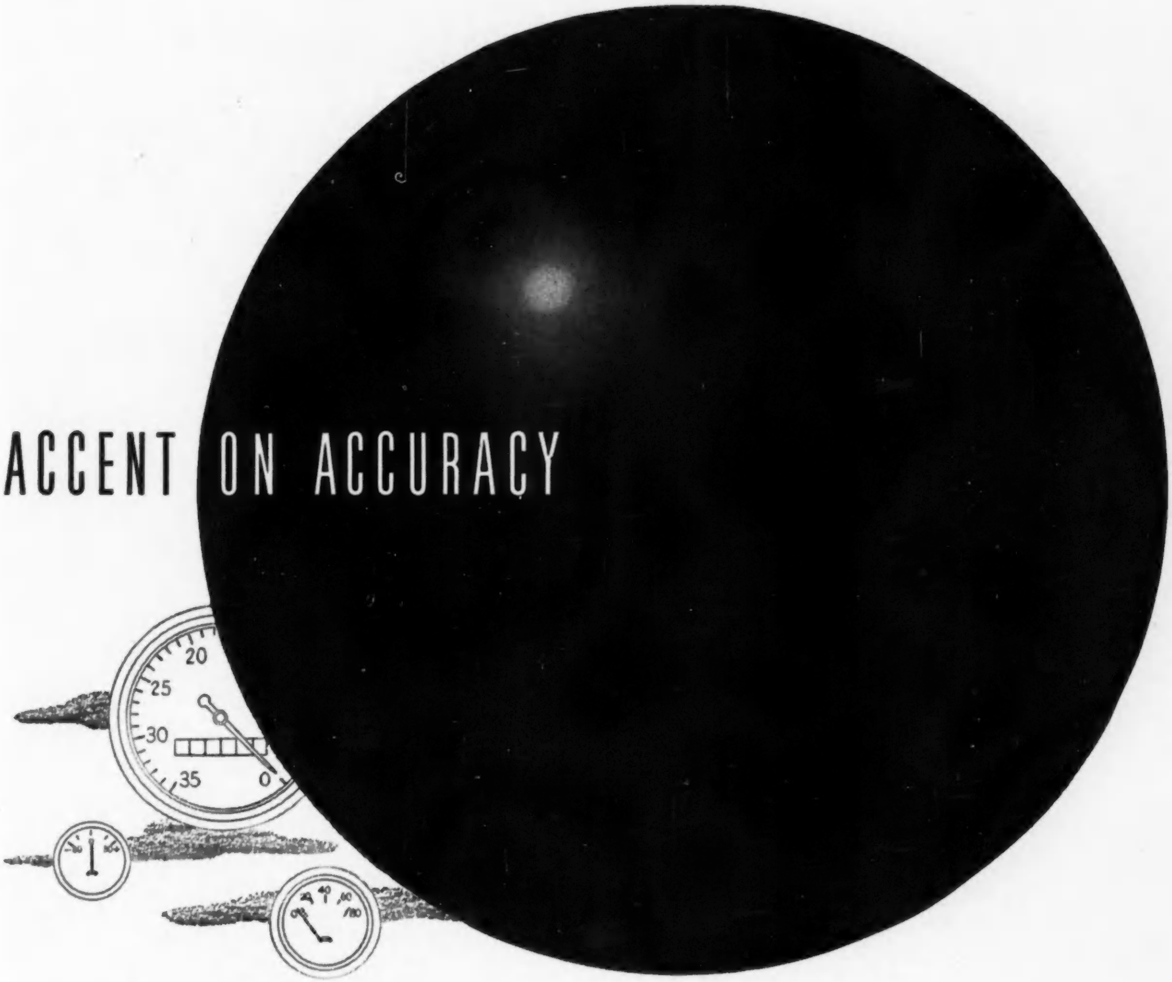
MARCH
1953

IN THIS ISSUE . . .

PUBLISHED BY THE SOCIETY OF AUTOMOTIVE ENGINEERS


The facts behind the facts at Perfect Circle
Chrome plated steel compression rings—pioneered by PC —offer greatly increased resistance to breakage!
Behind this statement lies the story of a decade of research, testing and development . . . of trial and error, and finally of trial and success.
During World War II Perfect Circle engineers, working with the Air Corps, first developed practical production processes for making chrome-plated steel compression rings. The ultimate high output aircraft engine achievements might not have been realized without experience gained in PC's experimental production unit.
Today, refined and improved PC Chrome Plated Steel Compression Rings are indispensable in many heavy-duty installations. Features of these special purpose rings are: greater resistance to breakage; higher unit pressure and conformability than obtained with cast materials; good heat stability.
Perfect Circle Corporation, Hagerstown, Indiana; The Perfect Circle Co., Ltd., Toronto, Ontario.
Perfect Circle
PISTON RINGS
The standard of comparison

ACCENT ON ACCURACY



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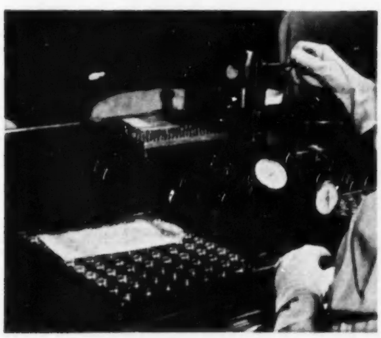

Scientific methods at New Departure instrument bearing plants assure precision production. Only workers with gloved hands, tweezers or special holding devices touch bearings in this dust-free area.

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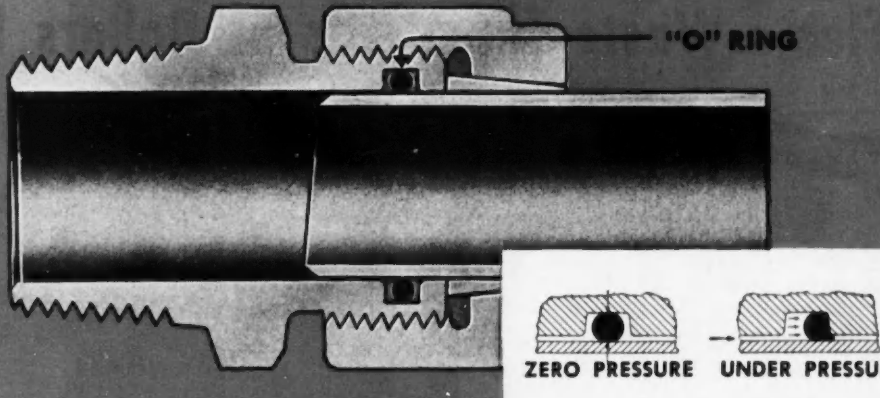
A PRECISION "O" RING

makes this coupling *leak-proof* and easy to assemble!



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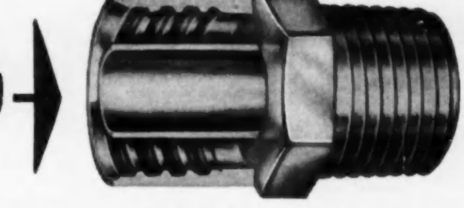
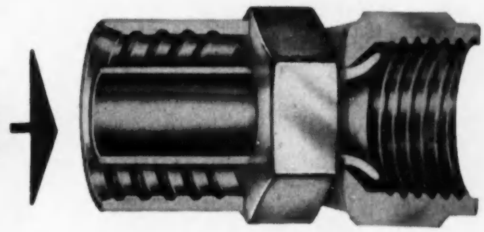


Flex-o-Tube Hose, and cross section of machined male fitting.

FLEX-O-TUBE ...finds brass makes fine fittings



Cross Section of machined and flared female fitting.

For quick, accurate and economical machining, free-cutting brass rod is preferred by many companies, such as Flex-O-Tube, Division of Meridan Corporation, Detroit, Mich. This company makes hose assemblies and fittings to conduct air-oil-water-gasoline and hydraulic power for the automotive, farm implement, machine tool and aircraft industries. Some of these hoses have a minimum bursting pressure of 20,000 pounds per square inch, which gives an indication of the tightness required, which can be obtained only by strength and accuracy.

Flex-O-Tube has found six points of superiority for brass over other metals, as follows:

1. Brass "flows," or is ductile, so that no cracks result during the crimping operation required to fasten the fittings to the hose.

2. Ductility and strength inherent in brass act to provide a superior seat to fittings designed to control fluid flow. Competitive metals are either too hard or too soft to give positive closing and tend to leak.

3. Where the design of the fitting is intricate, necessitating removal of considerable metal by machining, the automatic screw machines can be run faster with free-cutting brass rod.

4. Brass has a high scrap value, and the scrap sold back to the mill increases brass supplies.

5. The break-even point between brass and other metals is especially favorable to brass in the sizes of rod that Flex-O-Tube buys.

6. Customer preference is for brass, which is universally recognized as a quality metal. Hence brass fittings are more readily sold, and in fact often are specified regardless of size or price differentials.

Included in the Flex-O-Tube operations are machining, flaring, crimping, and annealing to assure the proper ductility for flaring and crimping.

Revere is an important supplier of brass rod to Flex-O-Tube, and has also collaborated with this customer through the Revere Technical Advisory Service.

If you wish information about brass and how one or more of the Revere brasses can add to the economy and saleability of your product, get in touch with the nearest Revere Sales Office. See your telephone directory or write direct.

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For the Sake of Argument

Queer People Are Normal . . .

By Norman G. Shidle

The engineer who stops seeing queer human reactions as intrusions on his operating norm goes far toward handling them well. Once he admits them as a normal part of everyday chores, he can handle them as well as anybody. He considers them as data pertinent to solution of the problem.

The engineer's training in clear-headed analysis equips him to understand people as well as any salesman—perhaps better. But he is clear-headed about human reactions only when he admits them to be facts, not just foibles. . . . when he recognizes the impracticality of any argument or sermon that begins: "If only people would . . ." or "If only people wouldn't. . . ."

The engineer's deep-rooted concern with facts is the keystone of his successful professional activity. Usually, he goes wrong only when his data are inaccurate or insufficient. That's why he goes wrong oftener when his problem involves people as well as things, spirit as well as matter.

Feelings and ambitions and hopes and fears are often a very real part of his professional problems. That data on them usually are inaccurate and insufficient doesn't make them any the less real.

The engineer's job analysis often gives him the privilege of confining his thought and action to formula and physical facts. His engineering principles bid him consider *all* the facts—tangible or intangible. So he listens with interest to President Eisenhower's inaugural dictum: "A people that values its privileges above its principles soon loses both."

Trying to encompass intangibles, the engineer is on a par with executives and lawyers and salesmen and financiers. Neither they nor he can translate these intangibles into an engineering formula. Those most experienced in human relations admit the need to feel one's way in every individual situation. Many believe in what Dr. Ralph W. Sockman calls "the contagion of works rather than the conviction of words."

But all those successful in human relations in industry seem to agree on one point: "Variable personal actions and reactions are normal, interesting parts of a business life—not irritating, abnormal phenomena."

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Norman G. Shidle
Editor

Joseph Gilbert
Managing Editor

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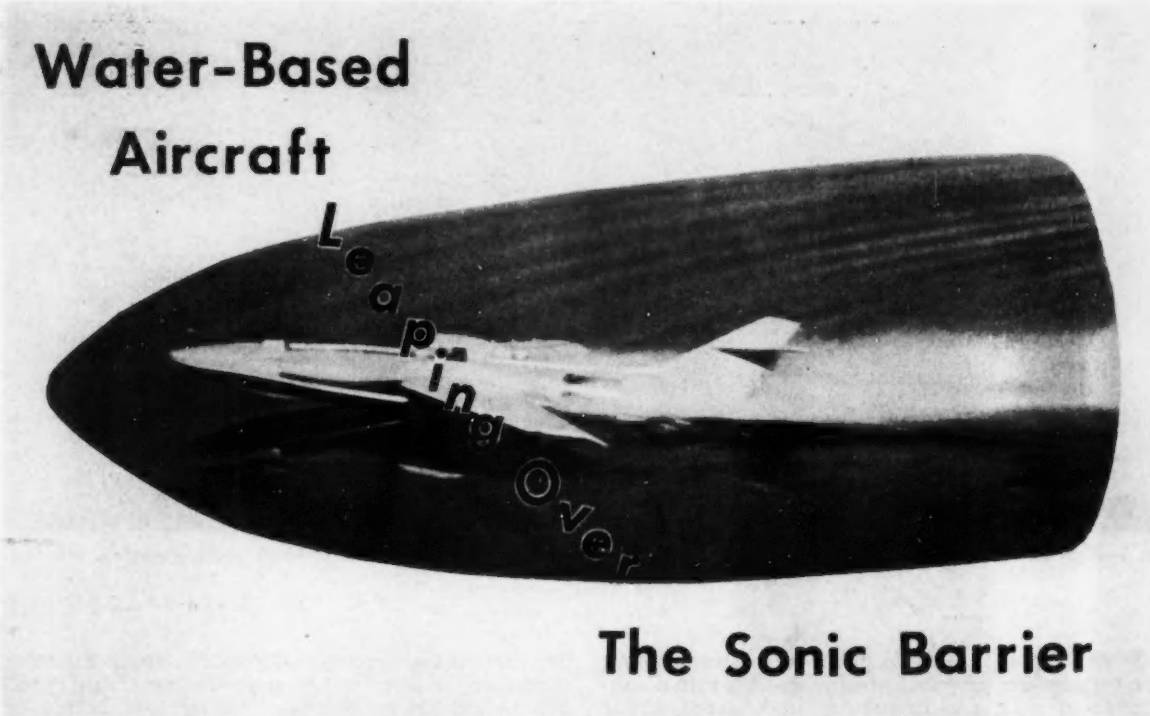
Contents—March 1953

Water-Based Aircraft Leaping Over The Sonic Barrier



. . . They can be just as fast as land-based planes now—thanks to dynamically similar models and a revamped design philosophy.

Ernest G. Stout, Consolidated Vultee Aircraft Corp.

Based on paper, "High-Speed Water-Based Aircraft" presented at SAE National Aeronautic Meeting, Los Angeles, Oct. 2, 1952.

NO longer does faster speed swing the balance in favor of landplanes over seaplanes. By giving aerodynamics first priority and making use of dynamically similar models, designers have been able to completely close this performance gap between land-based and water-based aircraft.

The thinking of naval architects, who literally visualized water-based aircraft as boats with wings, has been replaced with the concept that aircraft are first and foremost aerodynamic vehicles. In short, regardless of basing facilities, there should be no radical difference in appearance of aircraft designed for a specific aerodynamic mission. At about the same time, a design tool was born that vastly simplified the job of blending excellent hydrodynamic characteristics with superior aerodynamic forms—dynamically similar models.

In layman's terms, a dynamically similar model is a flying miniature of a full-scale airplane that will perform every maneuver of the full-scale aircraft directly to scale. To an engineer, it's a device that will automatically pick up every known or unsuspected force in the proper magnitude, point of application, direction, and sequence; integrate all these reactions instantaneously; and provide the observer with the resultant motion and rate.

Fig. 1 gives a graphic picture of how these unique research tools are put to use. In this case, a 1/10 scale model of the Navy XP5Y-1 turboprop flying boat is undergoing flight evaluation tests. Note that the model is self-propelled and radio-controlled from the beach.

The Navy XP5Y-1, for that matter, was one of the first water-based planes to assimilate turboprop engines. And it was able to do this because of its streamlined high length beam/ratio hull. Prior to

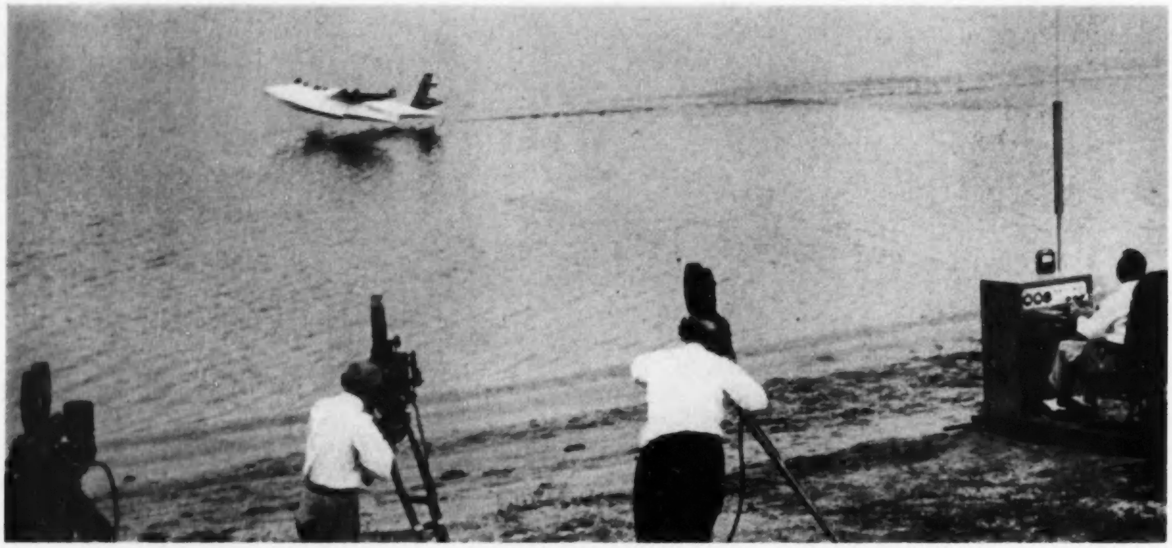


Fig. 1—Flight testing radio-controlled, dynamically similar models permits designers to find out in advance what's wrong, if anything, with their creations

this development, it just wasn't feasible to pour the tremendous power of turbine engines into a configuration with the inherently high aerodynamic drag of a flying boat. Landplanes, in the meantime, with their clean aerodynamic forms and retractable landing gear, were assimilating jet and turboprop engines with very little difficulty . . . and the speed margin between land and seaplanes was becoming an abyss.

The Tide Turns

The XP5Y-1, then, was a step in the right direction. And with its introduction, the hitherto diverging speed curves for land and water-based aircraft began to converge for the first time. (See Fig. 2.)

This was just the beginning though. Encouraged by this initial success, Convair's hydrodynamics laboratory went all out to close the remaining speed gap as quickly as possible. Under sponsorship of the Navy's Bureau of Aeronautics, a high-speed water-based aircraft research program was set up under the name, "Project Skate."

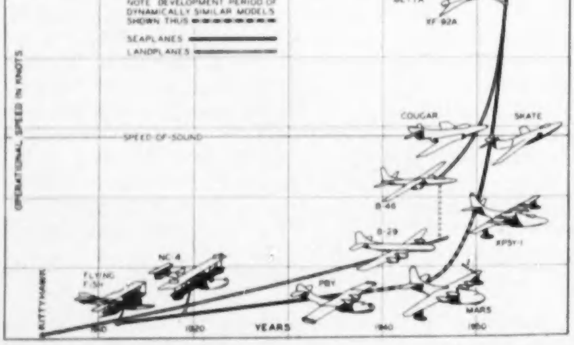


Fig. 2—Dynamically similar models were an important factor in closing the hitherto ever-widening gap between operating speeds of land and seaplanes

Starting with the XB-46 jet bomber (see left part of Fig. 3), a water-based version was developed —through use of dynamic models—that possessed excellent hydrodynamic characteristics with no loss in XB-46 aerodynamic performance. This configuration was designated Skate 1 and its derivation from the XB-46 is shown in the right half of Fig. 3. Note that the aerodynamic and hydrodynamic elements have been blended to the point where it is difficult to draw any sharp line of demarcation. Every section through the plane, from wing tip to centerline, consists of a low-drag airfoil shape. In fact, this blended hull—combined with the spray suppression offered by a fully retractable device known as a spray dam—pointed the way to achieving transonic and supersonic flight with water-based aircraft.

Crash Sonic Barrier

Following this initial success with the blended-hull configuration, a fighter requirement was set up by the Navy . . . and the research program was aimed at fulfilling it. The ability of the blended hull to provide a high Mach number aerodynamic configuration while incorporating excellent hydrodynamic characteristics was thoroughly developed in wind-tunnel and hydrodynamic tests. Altogether eight basic configurations, each represented by a free-body dynamic model, were analyzed during the course of a four-year study. At the top of page 17, one of these dynamically similar models can be seen undergoing a high-speed planing test. Called Skate 7, this two-place fighter-bomber is capable of transonic performance. At the close of

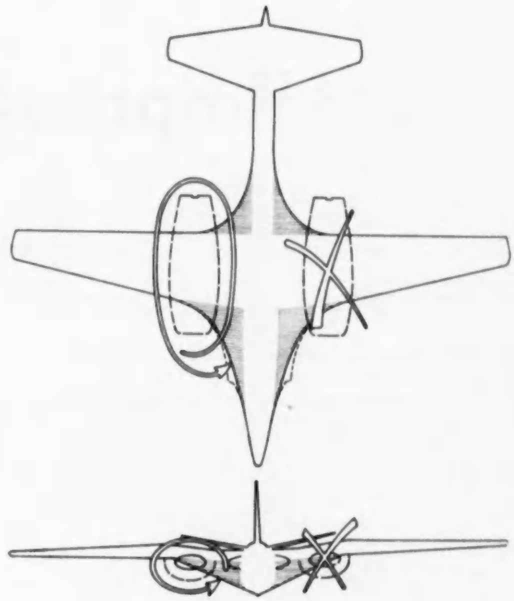


Fig. 3—Starting with the XB-46 land-based jet bomber, Convair engineers blended aerodynamic and hydrodynamic qualities into Skate 1. This water-based, blended-hull version of the XB-46 proved to be a happy combination of both

this program with Skate 9, it became apparent that a transonic water-based aircraft could be developed to meet or exceed any requirement for this range of speed. By using relatively inexpensive models, the equivalent of nine prototype aircraft had been completely developed and flight tested during the period normally required to produce and test one full-scale prototype.

The Skate program, then, showed conclusively that ideal transonic forms could be efficiently water-based. Naturally the next step was to apply the same technique to supersonic forms. Using dynamic models and the highly efficient delta-wing configuration, a supersonic water-based aircraft research program called "Project Betta" was initiated.

Little can be said of this Bureau of Aeronautics research program due to security restrictions. However, the dynamic model shown in Fig. 4 illustrates the result of applying this line of thought to a basic aerodynamic configuration incorporating a 60 deg delta wing. With the power loadings that will be available, the high deadrise blended hull of this plane holds out great promise for successful rough-water operation at high planing speeds. What's more, wind-tunnel tests indicate that desired aerodynamic cleanliness and supersonic performance can definitely be attained with this configuration.

It is of particular interest to note that this first Betta project attempt succeeded in completely closing the speed gap between land and seaplanes. (See Fig. 2.) The Betta project continues, and rigorous proof exists that water-based aircraft development will continue as fast as aerodynamic and powerplant development will permit. Perhaps the time has come to take another good look at water-based aircraft potential, now that technology has overcome its last barrier—speed.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.)

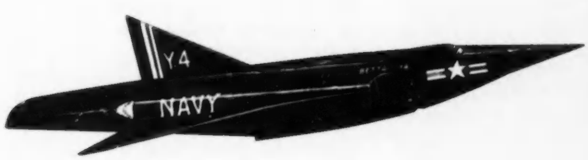
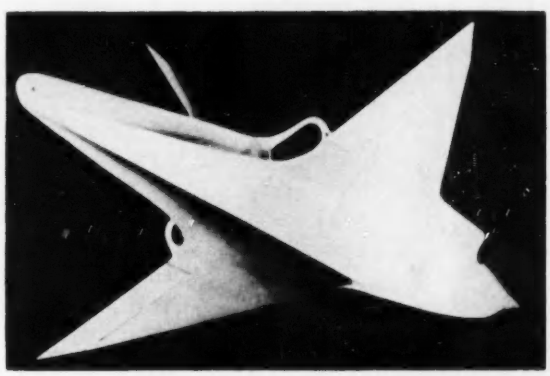


Fig. 4—This supersonic, delta-wing, water-based aircraft is said to be as fast as the fastest land-based jet planes



Improvised Testers Put

BENCH testing evaluates changes or improvements in truck and bus components quickly, cheaply, accurately, and without delay due to weather. Many of our test set-ups consist of scrap found around the shop—an old connecting rod, a few pulleys, a few hunks of angle iron, and a piece of cold-rolled steel—plus a lot of ingenuity.

At our plant we get requests from engineering to test a wide variety of components . . . gages, switches, hose, fittings, axles, clutches, fuel tanks, springs, and frames. These tests take from a few days to a few months to complete.

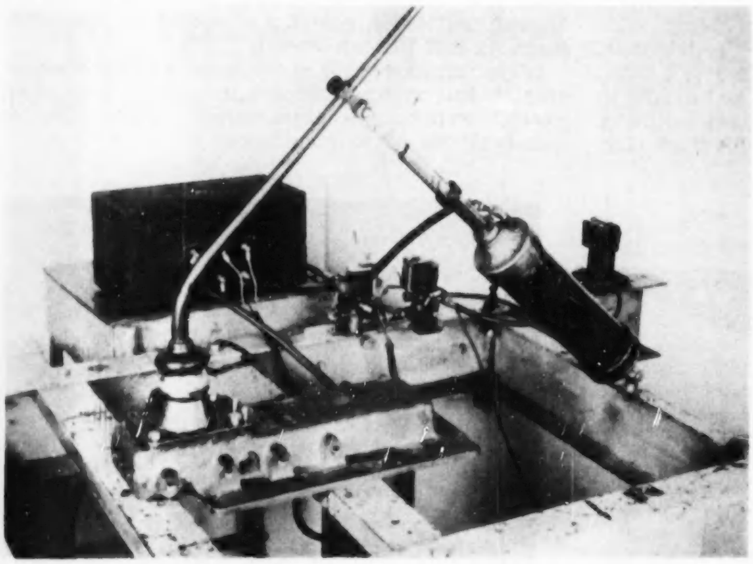
Requests generally stem from service complaints which indicate too much trouble with some particular unit.

What we first do is to set up a test which will produce the failure or difficulty complained about; then we record the time or number of cycles needed to produce it. With this base line established, we continue testing suggested improvements. This goes on until we come up with a correction that provides a definite increase in service life, as shown by the test record.

In setting up the test procedure, there are a few things to keep in mind. Don't create test conditions that accelerate a breakdown. You may kid yourself into making a better correction than is needed. Too mild a procedure may lead to accumulation of many test hours, and the conclusion that little or no improvement is needed.

It always helps to have a failed sample of the unit to be tested which has been returned from the field. Then you can arrange a procedure which duplicates the same condition in 20 to 50 hr of testing.

The examples that follow give you an idea of some of the things we do in our bench test department and how we do them.



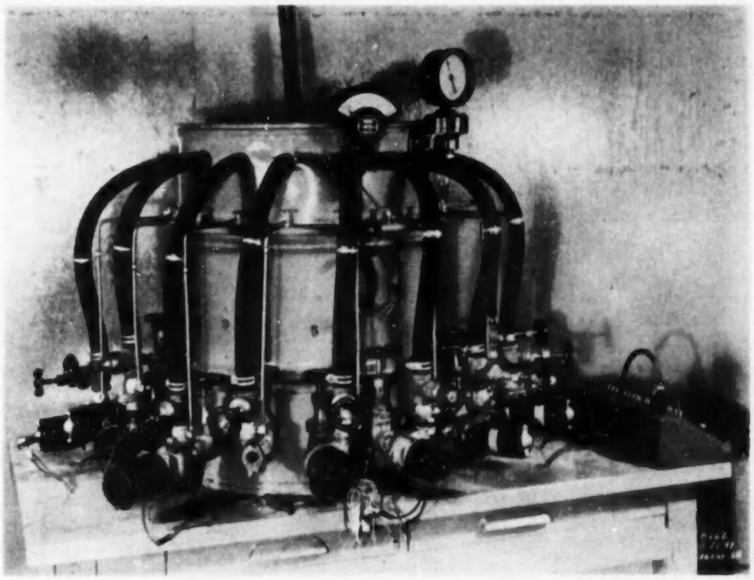
Shifty Tester

This setup checks the life of a truck transmission poppet and shift rail assembly. The double-acting cylinder pushes and pulls on the gear shift lever. This simulates shifting the rail and actuates the poppets. The electric timer energizes the magnet valves, which admit air pressure alternately to both ends of the cylinder. An electric counter records the cycles; it too is actuated by the timer.

Vehicle Parts Through Paces

Gil F. Roddewig, GMC Truck & Coach Division

Based on paper "Experimental Bench Testing Techniques for Truck and Bus Components" presented at SAE National Transportation Meeting, Pittsburgh, Pa., Oct. 24, 1952.



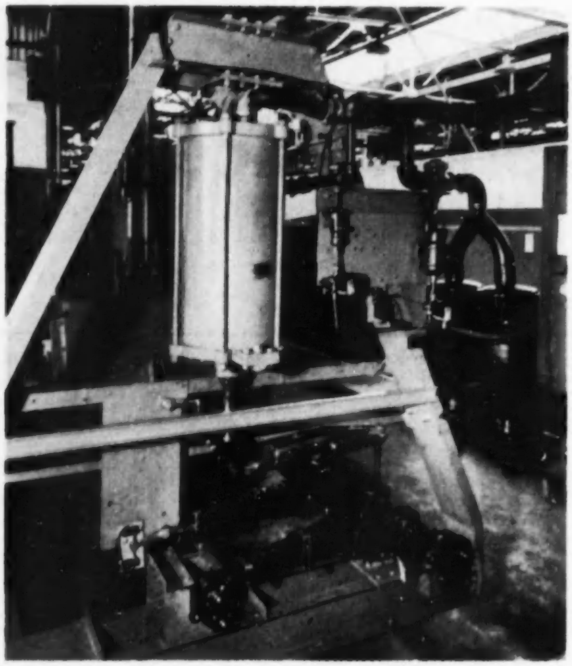
Pumps Put Through Paces

This arrangement tests 18 electric motor-driven water pumps used in coach heating systems. This set-up gives data on pump seals, motor bearings and brushes, current consumption, and water pump capacity. Valve in discharge line controls the pressure so that all units are operating under same load. Pressure of any individual pump can be checked by opening the valve connected to pump discharge and leading to gage manifold.

See-Saw Bouncer

Here is how we test packaging of military truck parts boxed for overseas shipment. The cradle is rocked on its pivot by the air cylinder. At the end of each stroke, the cradle bumps the wood blocks on the floor, gives its contents quite a jolt in opposite directions. We discovered quite a few shortcomings in our packaging procedures in this way. It leads to improved packaging, practically eliminating damage in shipment.

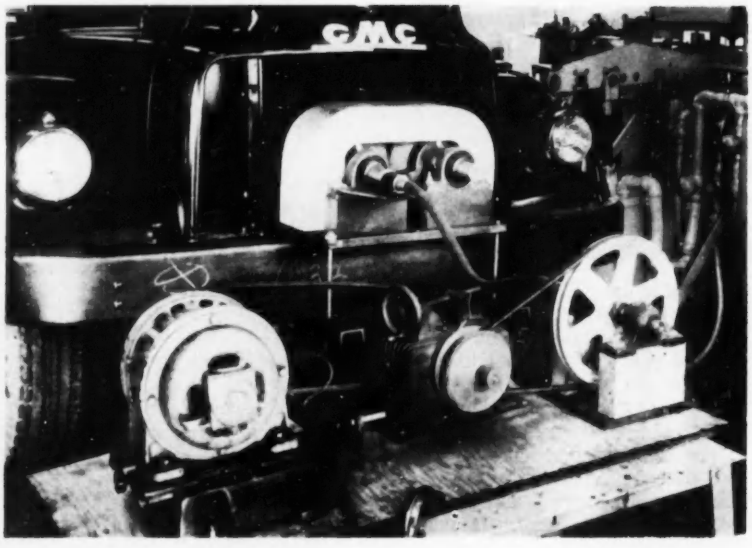
Turn page for more



Spring Flexer

Here we're testing two springs—one a production spring and the other one from a supplier who says his job will be more efficient. Both springs are deflected the same amount, so there is a direct comparison. Such a test also is useful in comparing life of spring pins and bushings. The 12-in. diameter power cylinder will produce a push of 11,000 lb, with 100 psi line pressure.

Shake Maker



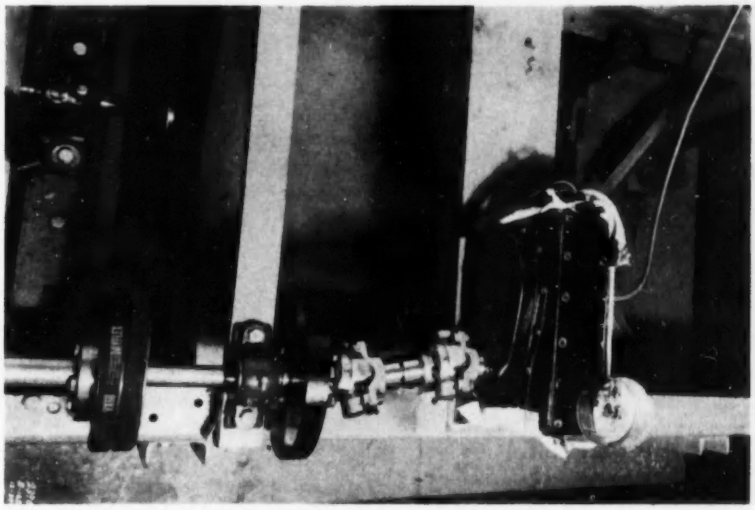
Often vibration is found to be the root of our troubles. So we test some of our vehicle components with this vibration machine. It consists of an electric motor driving a speed changer, which in turn drives the large pully and shaft at the right. A flexible drive shaft connects the pulley shaft with the driving shaft and gear of the vibrator, which drives the same size driven gear and shaft. Both gears have weights attached to them which meet at the center every revolution. So vertical forces are created by the machine and the period of these forces can be varied by changing the speed of rotation.

By rigidly attaching the vibrator to front bumper of a truck (as shown), the entire vehicle can be vibrated at different speeds. From this the natural periods of various parts can be readily determined.

Information from such vibration testing helps keep the natural period of vehicle components different from those of tires and axles. For example, if the frequency of the cab mounting is in the resonance range of the tires, the cab will vibrate excessively and deteriorate rapidly. By using the vibrator, we have even corrected difficulties reported under the all-inclusive term "shimmy."

Gear Torture

This set-up tests engine timing gears (inside the timing gear cover at right) for endurance. The driving shaft, connected to the crankshaft gear, has a small flywheel and double-jointed propeller shaft. The shaft runs at quite an angle, sets up uneven rotation in the crankshaft gear. Changing the angle of the joints or flywheel weight will vary the severity of the test.

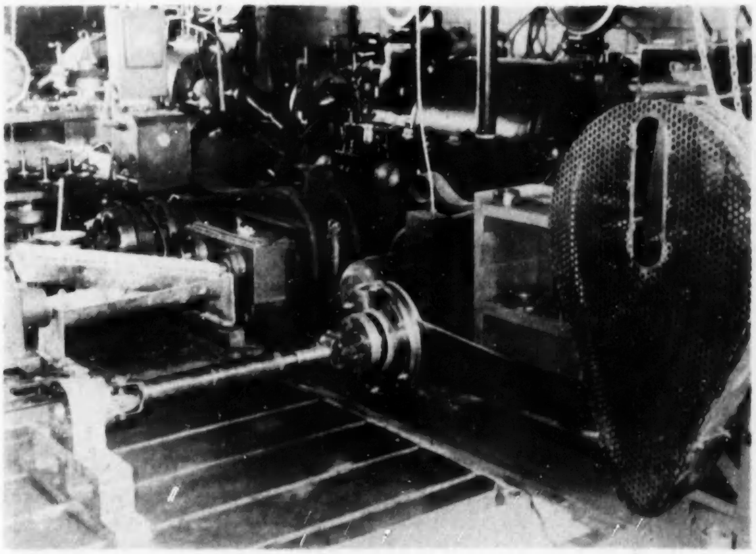


Testing at Spicer

From discussion by **W. P. Michell** Spicer Mfg. Division, Dana Corp.

Torque Tester

With this arrangement, we can do full-scale torque testing of propeller shafts, or practically any torque transmitting element. The machine is set by adjusting the stroke on a variable throw crank to produce the desired torque. This torque load is checked from time to time by weighing.



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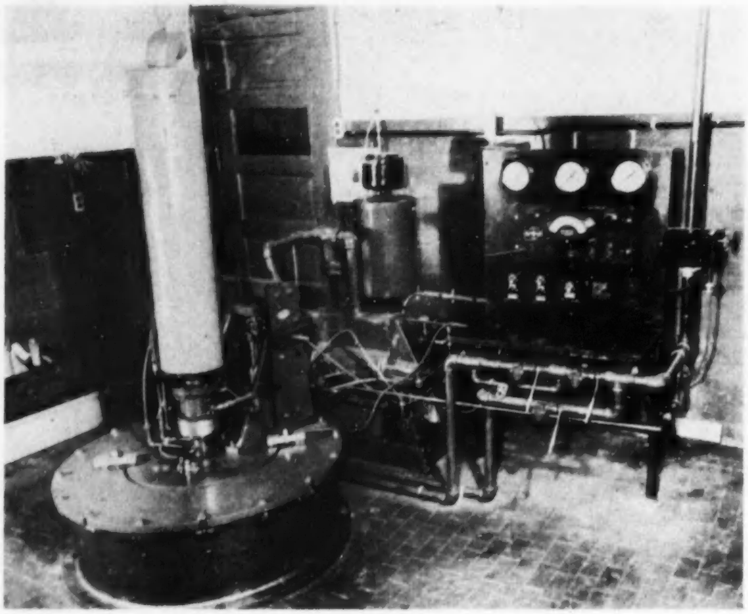
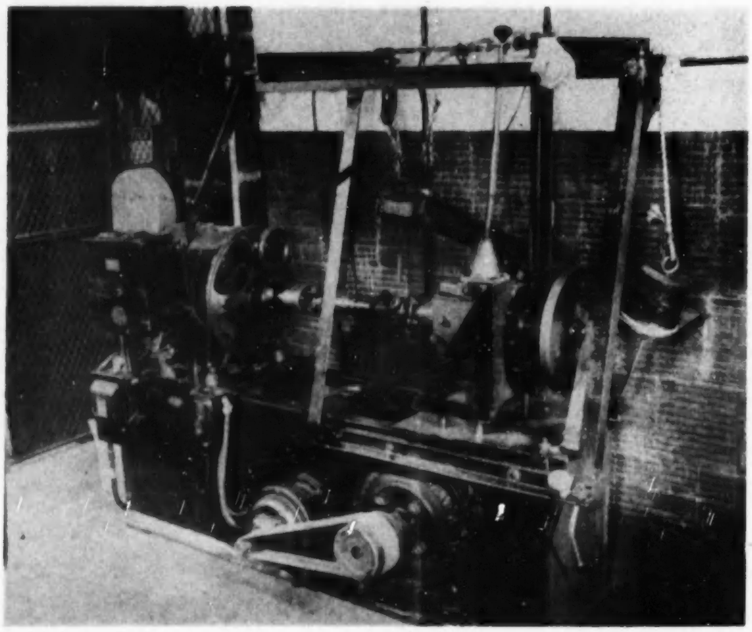


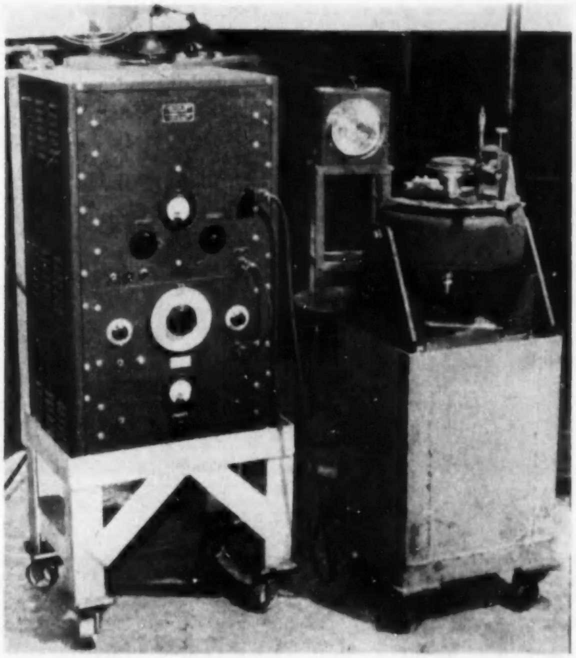
High-Speed Merry-Go-'Round

Units like clutches, converters, and flywheels are put through centrifugal bursting tests in this vacuum pit. We can go to speeds up to 40,000 rpm. An air turbine is the drive in this unit. The part tested is suspended on a small shaft.



Gear Clasher

This machine tests clashing of shift gears, mostly from a metallurgical viewpoint. It continuously shifts a gear with controlled force. The components that make up this unit are a variable motor drive input, inertia flywheel on output, and a separate motor, speed reducer, and weight system.

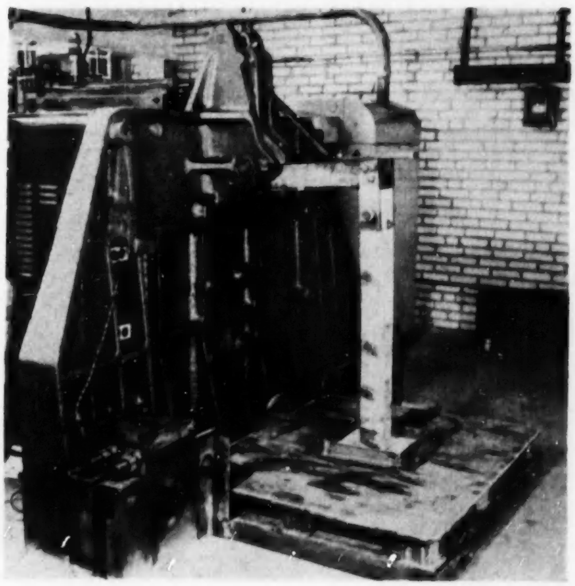


Failure by Resonance

Resonance or natural harmonic excitation can bring on fatigue failure. The control box in this set-up sends out controlled variable frequency and watts. This moves a magnet at variable frequency, force, and amplitude. When resonance is established, parts can be failed in a couple of hours. It would take weeks to do this in older machinery.

Testing at Clark Equipment

From discussion by **H. B. Felder** Clark Equipment Co.



Pallet Punisher

This machine normally is used for fatigue testing housings and axle shafts. It was temporarily converted for life test of plywood pallets.

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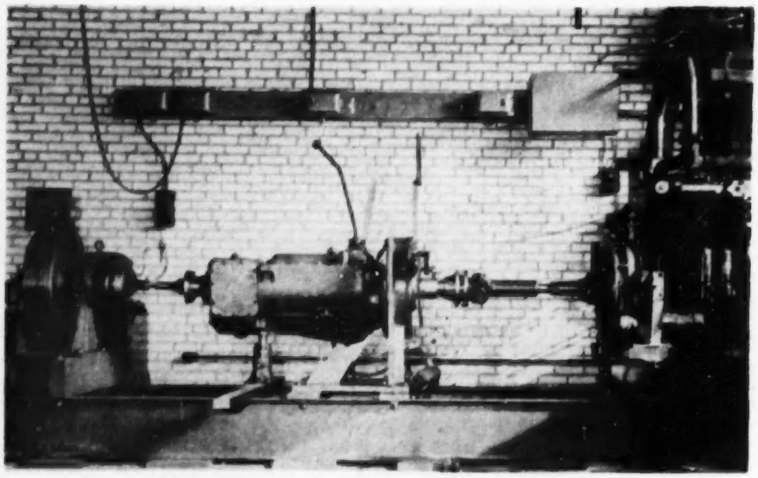
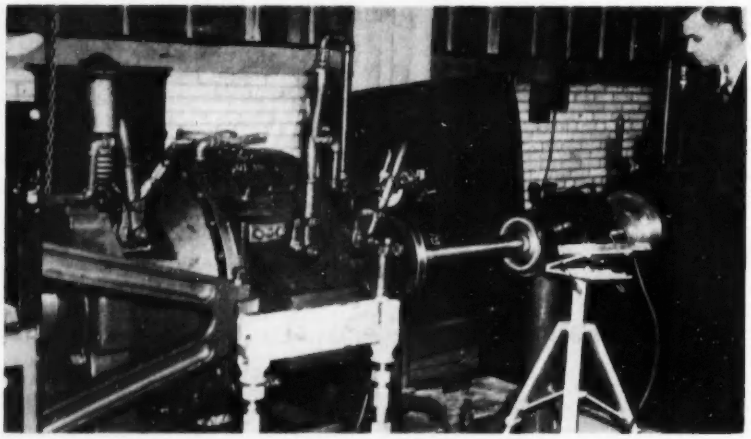


Adaptable Test Bed

This 240-hp engine, along with a pair of flywheels, can provide accelerated life tests of brakes, transmission synchronizers, and torque converters. Generous length of test bed is a great convenience.



Deflection Detector

In this case, dynamometers and a stroboscope are being used to study torsional deflection of an electrically insulated coupling for street railway trucks. Our dynamometers are set up so that we can move any machine to any position on 84 ft of floor rails, and get any combination of drives—tee, tandem, angular, or parallel.

Proof of the Pudding

One way to find what power is coming out of the rear axle of a coach is shown above. That's to back the vehicle up between a pair of dynamometers.

Buick's Got a V-8 Engine!

V. P. Mathews and J. D. Turlay, Buick Motor Division, General Motors Corp.

Based on paper, "New Buick V-8 Engine" presented at SAE Annual Meeting, Detroit, Jan. 14, 1953. Complete paper and discussion will be printed in the 1953 SAE Transactions.

BUICK's new valve-in-head V-8 engine develops 188 hp at the highest compression ratio in present-day gasoline engines—8.5 to 1. Yet it operates on currently available premium fuels.

The low stroke-bore ratio of this engine helps make it more than 1 ft shorter, 4 in. lower, and 170 lb lighter than its in-line eight predecessor. (See Fig. 1.) Width, on the other hand, is considerably greater, but it compares very favorably with that of other V-8 engines.

It was reailzed that the greatly reduced length and height of this 90 deg-V engine would be a great help to the chassis designer and body stylist, but that increased width would indeed be a problem. Designers therefore chose to minimize engine width by using a stroke-bore ratio of 0.8 and vertical, in-line positioning of the valves. As a result, the engine has a stroke of only 3.2 in. to go with its bore of 4 in. and piston displacement of 322 cu in.

Exhaust valves were made smaller than the inlet valves. Use of a relatively small exhaust valve permitted a more compact combustion chamber, improved valve cooling, and reduced cost—all without entailing loss in power. The reduced valve weight, in turn, brought the exhaust "pump up" speed well above that of the inlet valve, thus providing insurance against exhaust-valve breakage.

With the valve arrangement chosen, it was necessary that the exhaust ports cross the combustion chamber. However, the area of the port exposed to water was minimized by reduced head width, the angle at which the exhaust flanges were placed, and by the relatively small diameter of the ports.

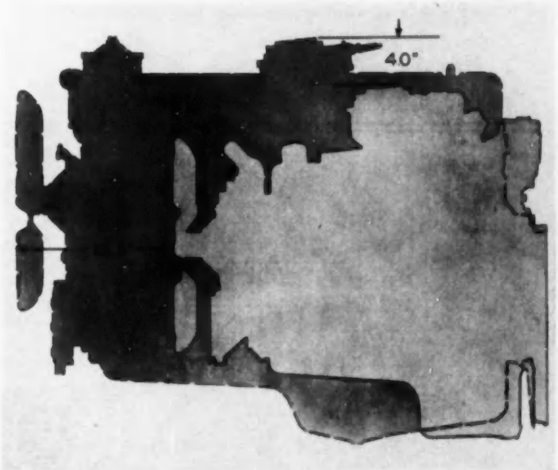


Fig. 1—The new V-8 engine is 4 in. lower and 13½ in. shorter than Buick's 1952 in-line eight

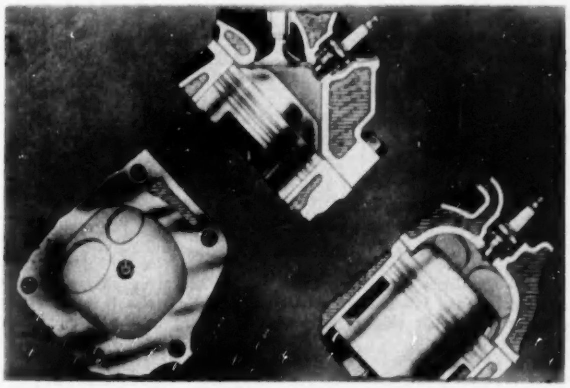


Fig. 2—Elongated cone-shaped combustion chambers provide room for both intake and exhaust valves on the same side. Note also that the spark plug is located at the apex of the cone

Cone-Shaped Combustion Chamber

Cone-shaped combustion chambers with spark plugs located at the apex of the cone were selected for several reasons. All combustion-chamber investigations made at Buick have shown the importance of short flame travel and high turbulence in reducing octane requirements. In addition, there is considerable evidence that a centrally located spark plug provides improved part-throttle ignition characteristics.

In the production design, therefore, the com-

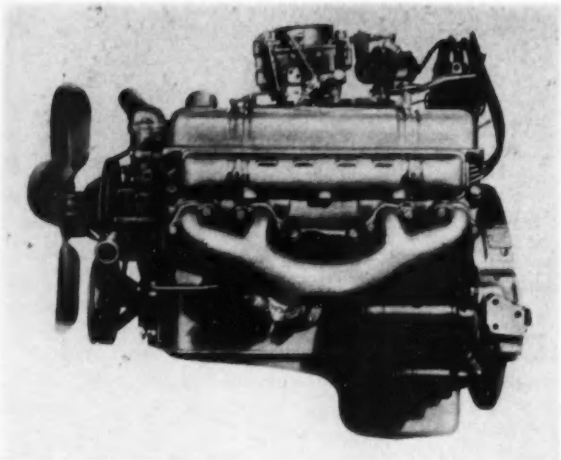


Fig. 3—Each exhaust valve has its own individual port and branch to the exhaust manifold. The manifold outlet on this side of the engine is directed forward to shorten the cross-over exhaust pipe and to move this source of radiant heat away from the starter

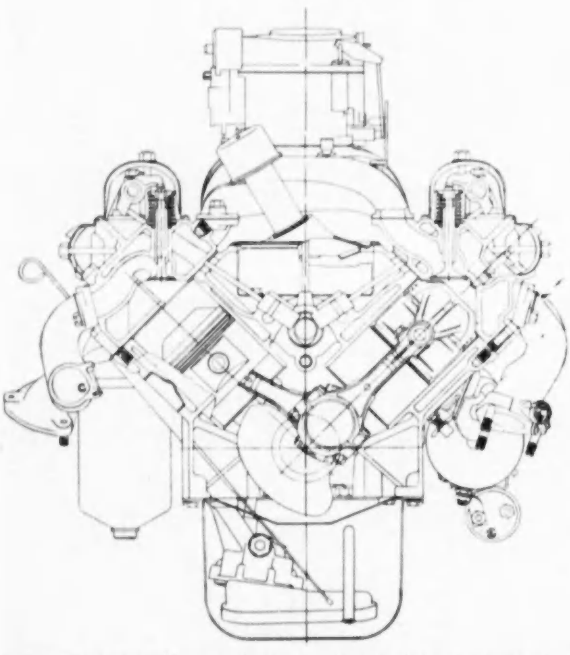


Fig. 4—The large diameter pistons are of one-piece aluminum alloy construction and full-skift trans-slot design. Note also that the valves are seated side by side at an angle of 45 deg to the cylinder axis

bustion chamber is of symmetrical inverted-V form with the spark plug located at the apex. (See Fig. 2.) The chamber is elongated, however, to provide room for both intake and exhaust valves on the same side. The piston crown which is raised and shaped to conform closely to the head configuration has a flat top surface.

The resulting compact combustion chamber gives minimum flame travel from the spark plug to the extreme edge of the effective portion of the combustion space. What's more, the close clearance space provided around the lower part of the piston crown results in high turbulence during the latter part of the compression stroke. These combustion-chamber characteristics, for that matter, make possible the use of the very high 8.5 to 1 compression ratio with remarkable freedom from combustion harshness.

Horizontally mounted rocker-arm covers and vertically mounted spark-plug covers continue to be used. The spark-plug covers protect the ignition wires from moisture and from excess radiant heat from the exhaust manifold. These covers also are effective in reducing television interference.

Each exhaust valve has its own individual port and branch to the exhaust manifold. This was done to avoid the exhaust overlap periods that would result with siamesed ports. The manifold outlet on the left side of the engine is directed forward (1) to shorten the cross-over exhaust pipe which passes under the front of the oil pan and (2) to move this source of radiant heat away from the starter. (See Fig. 3.) The right manifold outlet, on the other hand, is directed backward and outward so that the exhaust pipe will clear the full-flow oil filter at the rear of the engine.

The pistons, although much larger in diameter than those in previous models, are of one-piece aluminum alloy construction and full-skirt trans-slot design. Two conventional 5/64 in. compression rings and one 3/16 in. flexible steel oil ring are used. The piston pin is not offset. (See Fig. 4.)

The connecting rods are very short, being only 6 in. long. What with the short stroke of 3.2 in., the rod length-to-stroke ratio is a very conservative 1.875.

The crankshaft has five main bearings with the rear bearing flanged to carry the thrust load. Fig. 5 shows a comparison of this crankshaft with the one used in the 1952 straight-eight engine. It weighs only 56 lb—less than half the weight of its 1952 counterpart. The main and connecting-rod bearings are replaceable liners made of Durex 100A material. The exceptionally great bearing-journal overlap of over ¾ in. contributes to rigidity of the crankshaft.

Cam-Turned Counterweights

Due to the exceptionally short stroke and short connecting rods, chosen for the engine, space left for counterweighting was severely limited. (See Fig. 6.) Thus, to secure maximum useful counterweighting and constant minimum clearance with the bottom of the piston skirt, the outer surface of the counterweights is cam turned. And since the radius at the tips of the counterweights is limited by the clearance with the cylinder barrels, this

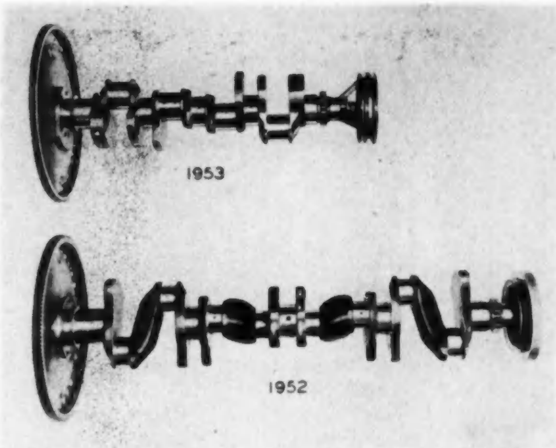


Fig. 5—The five-bearing crankshaft weighs only 56 lb—less than half the weight of the crankshaft used in Buick's 1952 straight eight

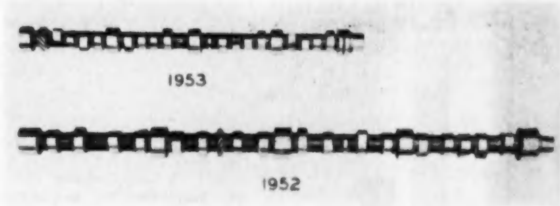


Fig. 7—The five-bearing camshaft is much smaller and lighter than the camshaft in the 1952 Buick in-line eight

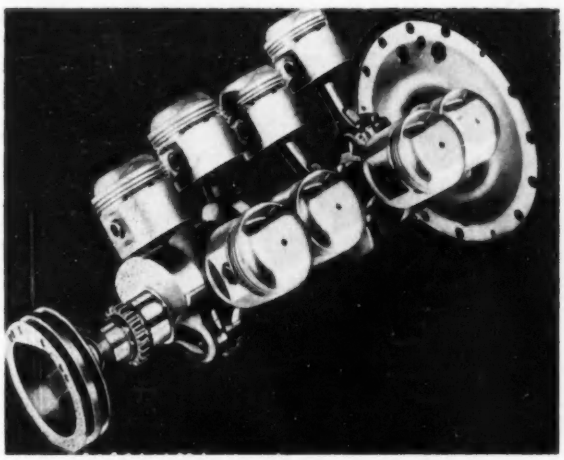


Fig. 6—Cam-contoured counterweights provide minimum clearance between the counterweights and piston skirts

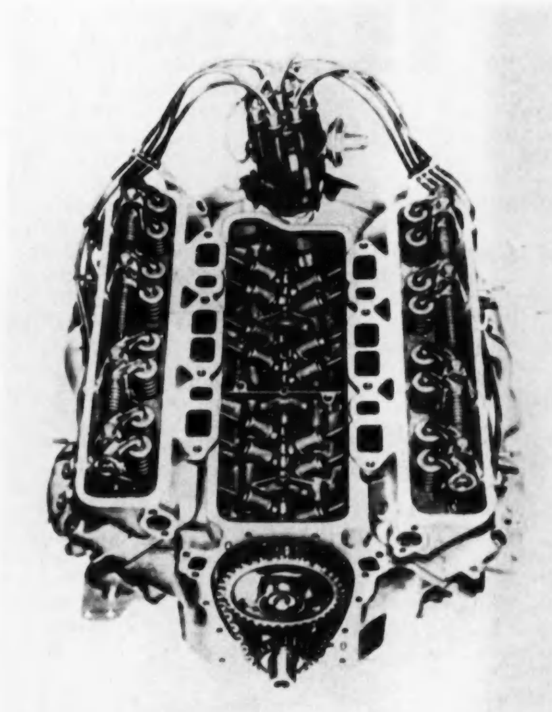


Fig. 8—The distributor and oil pump are located on the right side of the camshaft and are driven by a gear at the rear of the camshaft in the orthodox manner

barrel-clearance radius is blended into the piston clearance contour.

A small amount of counterweighting also is carried in the crankshaft pulley and in the flywheel. This method of completing the counterweighting is very effective from a weight standpoint because of the long span from the pulley to the flywheel. It also permits correction for any future piston weight changes without affecting the crankshaft counterweight tooling or balance.

Valves Seated at 45 Deg Angle

The arrangement of the valves and valve-actuating mechanism is shown in Fig. 4. Note that the valves are arranged side by side at an angle of 45 deg to the cylinder axis. The reversed position of the rocker arms results in a very compact cylinder head. This design also makes possible a common horizontal gasket surface for the rocker-arm cover and for the intake manifold which greatly reduces the sealing problem.

The valves themselves are ⅞ in. shorter than the 1952 straight-eight valves and the dual valve springs are 7/16 in. shorter. This reduces both valve operating inertia and material cost.

The pearlitic, malleable-iron rocker arms are very small and are of the non-adjustable type. The rocker arm bearings are broached with eight longitudinal grooves. These not only control the amount of oil metered to the valve stems and push rods, but

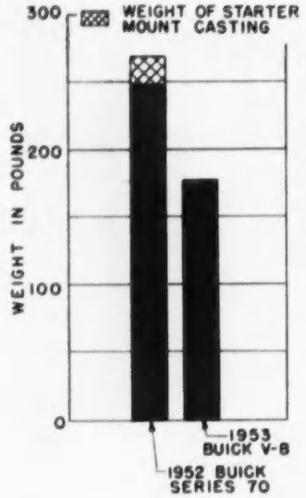


Fig. 9—Crankcase weight is substantially less than that of the 1952 Buick straight eight. Elimination of a separate starter mounting casting helped

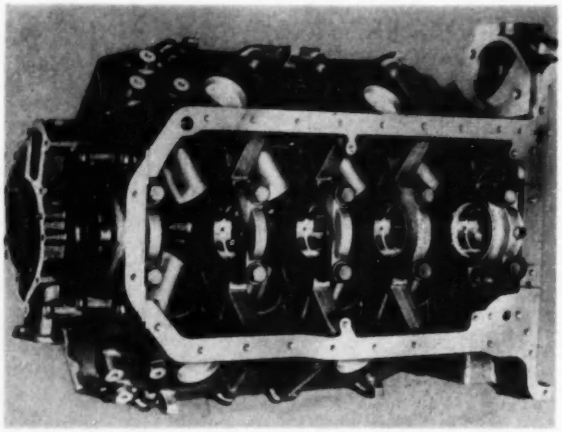


Fig. 10—The crankcase flange extends far enough below the centerline of the crankshaft to permit use of a flat, one-piece oilpan gasket

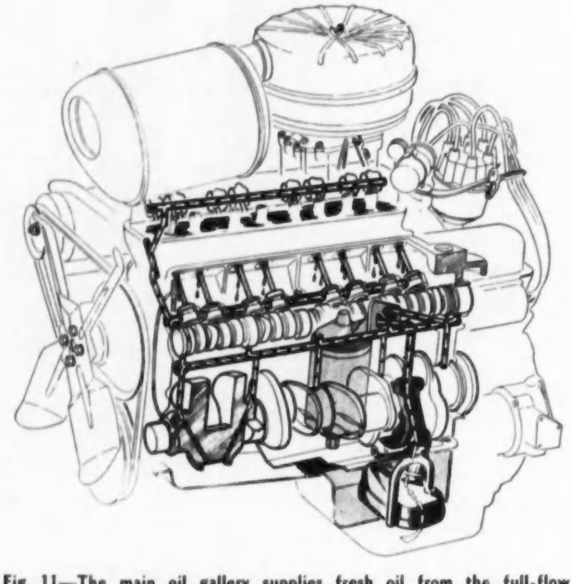


Fig. 11—The main oil gallery supplies fresh oil from the full-flow filter to the main, camshaft, and connecting-rod bearings. Two secondary galleries, one on each side of the camshaft, meter oil to the hydraulic valve lifters and valve rocker arms

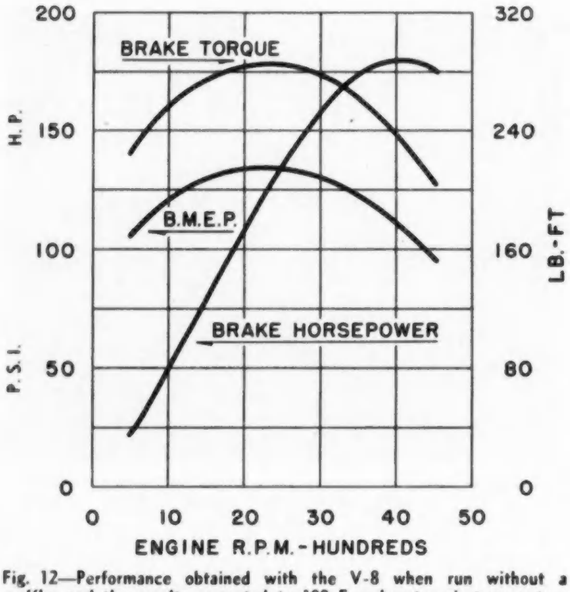


Fig. 12—Performance obtained with the V-8 when run without a muffler and the results corrected to 100 F carburetor air temperature

they also have proved so effective in preventing rocker-shaft scoring that the antiscuff coating formerly used is no longer necessary.

The push rods are of $\frac{1}{4}$ in. diameter solid rod. They have $\frac{3}{8}$ in. spherical diameter ends to eliminate excessive short wear at these critical points. The exceptionally short $8\frac{3}{8}$ in. push rod is made possible by the compact engine design.

Hydraulic valve lifters of the diesel-equipment type are used. The bodies are cast iron and the chilled wearing faces are ground flat and ferrox coated. The steel camshaft has cams 9/16 in. wide, ground without taper. No attempt is made to spin the lifters, although some lifters do turn as a result of manufacturing alignment variations.

The camshaft which is carried in five bearings is unusually small and light. (See Fig. 7 for comparison with 1952 camshaft.) The timing chain drive is lubricated with overflow oil from the front camshaft bearing.

The fuel pump eccentric is a hardened and chrome-plated cup stamping. It is driven from the front of the camshaft sprocket.

The distributor and oil pump are driven by a

gear at the rear of the camshaft in the orthodox manner. (See Fig. 8.) However, the distributor and oil pump are located on the right side of the camshaft. This arrangement, by putting distributor-gear thrust upward, eliminates the need for an additional bearing in the crankcase to take the thrust load.

Crankcase Weight Cut

Crankcase weight is substantially less than that of the 1952 Buick in-line eight. (See Fig. 9.) This was accomplished in a number of ways.

For example, in the new V-8 the starter mounting is carried on the flywheel housing, which is an integral part of the crankcase. This eliminated the weight of a separate starter mounting casting.

What's more, the crankcase flange was extended far enough below the crank centerline to permit use of a flat, one-piece oilpan gasket. (See Fig. 10.) Not only did this construction offer sealing advantages but, contrary to accepted opinion, it reduced weight.

Attachment to the bulkheads of the portion of the cylinder bores that extended below the water jackets was avoided by casting $1\frac{3}{4} \times 3$ in. windows in the intermediate bulkheads. This effected a further weight saving.

Just as efforts were made to reduce crankcase weight, so was special attention given to providing the best possible lubricating system.

With this in mind, a deep oil pan was chosen and the oil screen located near the bottom. This was done to provide a maximum depth of oil to minimize splashing and foaming and insure a constant supply of oil even during fast acceleration or turns.

Next, a horizontal baffle was placed over the entire sump area. This brought about reduced aeration of the oil by preventing crankshaft oil fling-off from churning the sump oil and oil in the sump from being thrown against the crankshaft. A standard Buick oil pump was mounted on the crankcase flange rail, a position made possible by the dropped rail design.

Triple Oil Gallery Lube System

The resulting lubricating system is shown in Fig. 11. Oil is carried by drilled passages to a full-flow oil filter in which the filter element is mounted vertically. From the filter, the oil is delivered to the rear of the main oil gallery. (This gallery is contained in a cast-in steel tube which runs the entire length of the block between the crankshaft and camshaft.) This gallery supplies all the camshaft, main, and conecting-rod bearings.

Two secondary galleries, one on each side of the camshaft, meter oil to the eight hydraulic valve lifters in each bank of cylinders. These galleries are supplied with oil at reduced pressure through drilled passages which register with a metering groove in the front camshaft bearing. Drilled passages from the front end of these oil galleries lead to the rocker-arm assemblies.

The separation of functions of these oil galleries has several advantages. Pressure in the main gallery is not affected by lifter clearances or leakage, since oil feed to the lifters is controlled by the camshaft groove. Oil velocities are reduced in the lifter galleries, since they feed only the lifters. Resulting lower oil velocity and oil pressure aid in the elimination of air bubbles at the front end of the gallery.

12-V Ignition System

The present trend toward higher volumetric efficiency and higher compression ratios in passenger cars has created a problem for electrical engineers. Even under optimum conditions, the secondary voltage obtainable with a 6-v primary system is closely approaching the minimum firing voltage of the spark plugs. Several attempts to increase the secondary voltage of 6-v systems have met with at least temporary success. However, in view of ever-increasing secondary voltage requirements, Buick decided to use a 12-v electrical system on the V-8 engine for 1953.

Finally, let's take a look at what the engine can do. Fig. 12 shows performance obtained under test No. 7 of the General Motors test code. This test is run without a muffler, and results are corrected to 100 F carburetor air temperature. The 60 F correction factor commonly used will increase the horsepower to 188, the maximum torque to 298 lb ft, and the bmep to 139 psi.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Based on Discussion

C. J. Livingstone, Gulf Oil Co.

As one who will be concerned with fuel requirements later on, I am disappointed that the authors did not see fit to present more data on this subject.

Our experience with other high-compression ratio engines indicates that the most critical fuel requirements occur when the engine is operated at light loads. It's true that detonation trouble with premium fuels can be corrected by pulling back the spark. But when autoignition is encountered there seems to be no solution.

Consequently, any data that the authors can present on fuel requirements after deposit accumulation at light load would be appreciated.

T. A. Scherger, Studebaker Corp.

In mentioning crankshaft balance it was stated that a small amount of counterweighting is carried in the crankshaft pulley and in the flywheel. This brings up the question of method of balancing. Is the crankshaft balanced in production with the flywheel and crankshaft pulley assembled? If this is the case, what provision is made for servicing the crankshaft pulley in case it is damaged in the field? Doesn't this type of balancing give somewhat higher bearing loads on the front and rear

bearings or does the high overlap of the bearing journals take care of this?

Also, no mention of spark advance was made for this 8.5 to 1 compression ratio engine. Is spark advance used for maximum torque at relatively low speeds or is some sacrifice in full-throttle power made for octane numbers, thereby obtaining the benefit of the high compression ratio for part-throttle fuel economy?

Finally, the ratio of sealing volume per cubic inch of piston displacement is unusually high for this engine. No mention of blowby was made. If data are available, what are the blowby characteristics of this engine?

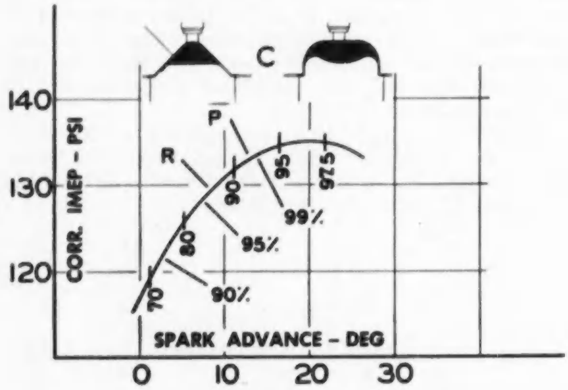


Fig. A—This combustion chamber requires about 92.5 octane fuel to operate detonation-free at 99% of maximum engine power

A. J. Blackwood, Standard Oil Development Co.

Both engine manufacturers and the petroleum industry have done an excellent job in giving the public more economical and better performing engines over the years. That trend will no doubt continue.

However, it should be recognized that improvements in so-called mechanical octanes—through better piston design, better valves, better induction systems, better cooling systems, and so forth—provide improved economy even at the current octane number levels.

On the other hand, since there are already 40 million cars on the road, and because the petroleum industry cannot make octane increases to satisfy specific cars which have higher octane requirements, the economic advantage will be slower materializing if we rely solely on chemical octane improvement.

D. F. Caris and F. A. Wyczalek, General Motors Research Laboratories

One way to achieve higher compression ratios is to build mechanical octane numbers into an engine. The combustion chamber in the new Buick V-8 engine is the result of such a mechanical octane development program.

The first step in the evaluation of various combustion-chamber designs was to develop a test that would, in so far as possible, leave combustion-chamber design as the only variable. Thus, a constant compression ratio of 9 to 1 was maintained; air/fuel ratio was adjusted for maximum knock for each fuel used; all designs were rated with combustion chambers free of deposits; humidity, pres-

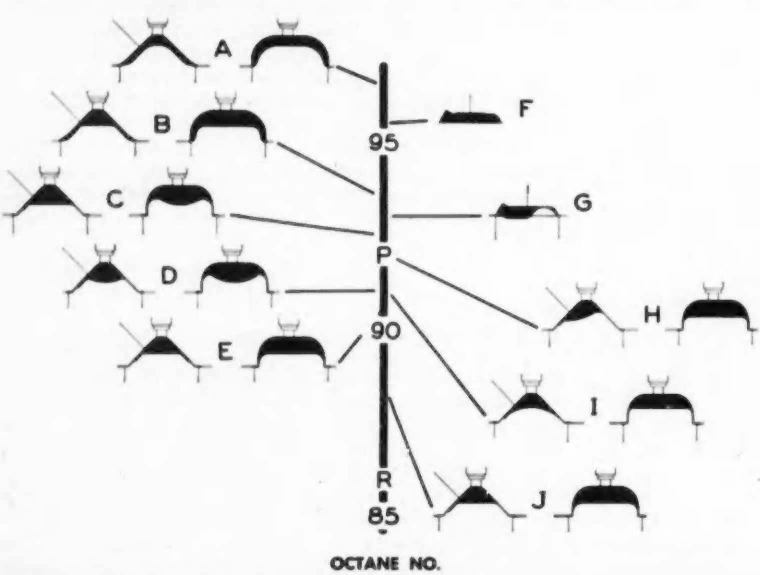


Fig. B—This octane tree shows that combustion chamber J, the design selected for the Buick V-8, has a fuel octane requirement eight numbers below that of chamber A, the design originally considered for the engine

sure, and temperature were held to definite values; and such mechanical variables as valve timing, cam design, and valve sizes were kept constant.

Fig. A shows results of a typical fuel rating test of a combustion chamber. (The shape of the chamber tested is shown by the two cross-sectional views. Valves are located at a 45 deg angle, the spark plug at the top of the chamber.) At any given speed, the procedure consists of obtaining a spark fishhook—the maximum imep that an engine can develop on a particular fuel without knocking. The curve that results from such a series of tests at 1000 rpm shows that this combustion chamber requires about 92.5 octane fuel to operate detonation-free at 99% of maximum power. It also can be seen that premium gasoline will permit operation at almost 99% maximum power. Regular gasoline, as rated by this combustion chamber, is equivalent to approximately 86 octane fuel.

The results of similar tests made with other combustion-chamber designs are summarized in Fig. B. This octane tree was made by taking the octane rating for all chambers at 99% of maximum power, 1000 rpm, and 9 to 1 compression ratio and arranging them along a vertical octane number scale. In addition, the research ratings of regular (86) and premium (92) gasolines are also labeled. It can be seen that almost all changes in combustion chamber shape for this particular investigation consisted of simply changing the configuration of the pistons.

Detailed examination shows that chamber A, the original design for the Buick engine, requires 96½ octane fuel to operate at 99% output, while chamber J, the design selected for the production engine, requires only 88½ octane fuel. This reduction in octane requirement of eight numbers is a fine example of mechanical octane improvement.

D. P. Barnard, Standard Oil Co. of Indiana

The 8.5 to 1 compression ratio of this engine fills us at once with admiration and concern: admiration for the strides in engine development which justify placing such a compression ratio in the hands of the general public; concern over whether the petroleum products which our industry makes—and will be able to make in the foreseeable future—will be entirely satisfactory.

Our misgivings do not reflect defeat. They merely recognize troubles as an inevitable part of the price of progress.

Every increase in compression ratio brings up pictures of more combustion-chamber deposit problems. Of course, we realize that the modern engine at its compression ratio is less susceptible than its ancestors of a generation or more ago. Nevertheless, even the most modern gasoline engine is wanting in ash-handling capacity, as was once pointed out by Bill James.

Recognizing that we will never be completely free of combustion-chamber deposits, what to do about them is likely to remain a major problem. But just as the engine builder continually seeks to improve his design, so we in the oil industry will keep trying to improve our products. However, lest some of us become too impatient to achieve the magic "100," let it be noted that the effective knock-rating improvement in going from present average levels to 100 is at least as great as the sum of all octane improvements made up to the present.

Closure

J. D. Turlay and H. W. Boylan

We will try to answer the question about effect of carbon accumulation on engine fuel requirements in a general statement of our test results with the new engine. Then we will take up point by point other specific questions raised by discussers.

On our carbon accumulation schedule for wide-open-throttle operation (24 hr on power runs from 600 to 4500 rpm), we take a torque loss from the clean condition of 2½% at maximum torque. At peak horsepower, we take a loss in torque of 3½% from the clean condition.

On our carbon accumulation schedule consisting of 1 min at 600 rpm closed throttle, followed by 3 min at 1500 rpm open throttle . . . for a 24 hr period, we have a loss in torque of 4½% at 1000 rpm and 5% at 2000 rpm. (This is comparable to the loss with the 1952 Buick in-line engine which amounts to 4½% at 2000 rpm.)

Using a road test schedule which consists entirely of low-speed, part-throttle operations, it was found that the engine requires 88.5 octane fuel with the engine clean, and 91.5 octane fuel with the engine not clean.

Now for the question asking how much power loss we take at the low end due to retarded spark. We take approximately 5% loss at 600 rpm with this loss diminishing to 1% at 2200 rpm. From this speed, and on out, the spark is set M.B.T. This power loss taken at the bottom end of the power curve is no different than the loss taken on most new engines. It is inconsequential in the Buick car when a Dynaflow transmission is used. (The Dynaflow does not allow the engine to operate at wide-open-throttle much below 1700 rpm.) In the case of synchromesh-transmission equipped cars, it is necessary to reduce the compression ratio to 8 to 1 and use premium fuel to obtain satisfactory operation from a detonation standpoint.

As for blowby characteristics of the engine, the rate of blowby is no more, in fact, it averages slightly less than that of our past in-line eight engine with comparable displacement.

Finally, the crankshaft, pulley, and flywheel are not balanced as an assembly. The crankshaft and the pulley are balanced separately, as in past production engines. The engine is balanced at final assembly as a unit, the flywheel being drilled to correct any out-of-balance condition. These operations are the same as used for past production engines and should cause no new service problems.

Electronic Equipment

ELECTRONICS has come of age in the aviation industry. It is no longer relegated to an unimportant position in the overall aircraft picture. In modern aircraft it has reached the point where, in the case of guided missiles, electronics now performs those functions formerly requiring the human element. This maturity of aviation electronics was reflected in the attitude and discussion of both panel members and audience alike. However, much remains to be accomplished in this rapidly advancing field—as may be discovered in the following points of discussion.

Functional Testing

How much functional testing of electronics equipment must be done by aircraft companies seems to depend on two factors: (1) the complexity of the equipment and (2) the extent of testing performed by the manufacturer of the equipment.

It was emphatically agreed that duplication in testing must be avoided to reduce costs and save time. The electronics manufacturer ordinarily tests the equipment, both components and the complete system, before it leaves his plant. When shipped to the airframe company, or perhaps to a military supply base, the equipment may be installed immediately in an aircraft or it may be stored until it is required. In either case it is probably tested again before installation, and again immediately before flight test.

Experience has shown that, with increased handling and testing of equipment, there is an increase in the number of failures. If possible, an agreement should be reached as to the amount of testing per-

Members of the Electronics production forum were (left to right): L. M. Welsch, assistant division superintendent of electronics, Boeing Airplane Co.; Lester L. Galloway, general foreman, electronics department, North American Aviation, Inc.; Secretary C. H. Hansen, Public Relations Department, AiResearch Mfg. Co.; Panel Leader Charles W. Clarke, manager, manufacturing controls, AiResearch Mfg. Co.; Panel Coleader E. M. Boykin, manager field engineering, Hughes Aircraft Co.; M. J. Fayrweather, technical adviser, electronics, Northrop Aircraft, Inc.; and A. F. DuFresne, director quality control, Consolidated Engineering Corp.

for Aircraft

C. H. Hansen, AiResearch Mfg. Co.

Secretary's report of production forum discussion on "Electronics," held at the SAE National Aeronautic Meeting, Los Angeles, Oct. 1, 1952.

formed at the manufacturer's plant in order to prevent duplication at the aircraft plant. There is always the pessimist who points out that the life of electronics equipment is limited, and it is liable to be used up in testing if one is not careful.

Each company has its own ideas as to when the functional tests should be made. Some run tests before installation in the aircraft, others install the equipment and then run their tests. In each case, economics guides the action. In a small fighter, where inaccessibility may require tearing out expensive panels and framework, it is felt that system testing should be completed before installation. In the case of a bomber or large transport, it is often possible to take testing equipment into the ship itself to check out the system.

The difficulty of joining components made by different manufacturers into an overall system can sometimes be alleviated by complete check out of the system before installation.

Plant layout may determine when functional testing takes place according to the position assigned electronics in the assembly line. It was suggested that aircraft designers could simplify the problem by designing panels and sections that were more accessible for installation and testing.

The organizational responsibility for making functional tests was generally felt to belong with the electronics department personnel because of their familiarity with and knowledge of components, systems, and test equipment. Under normal circumstances, the aircraft should be cleared from the electronics group before going on to the next assembly station. There seems to be a general trend to place functional test responsibility with electronics departments rather than inspection, quality control, engineering, and the like. Again, determining who should make these tests may depend somewhat on plant layout, space, facilities available, and type of test equipment being used.

Personnel who perform the functional testing must have a solid background and knowledge of electronics. They should have specific training in specialized test equipment. In some instances, component specialists are necessary in the group, possibly representatives of the equipment manufacturers. It is desirable to have supervision in these groups at an engineering level.

With the knowledge that electronics equipment is not perfect as yet, a close liaison on functional testing developments between electronics manufacturers and airframe companies is essential. It is also advantageous to have these three main factors under discussion—facilities, responsibility, and personnel—consolidated into one department within individual companies.

Reducing Time for Making, Proving Installations

With the rapid progress being made in the field of aviation electronics, constant improvement is demanded in methods of developing and proving operable installations. Working out a time span compatible with the master schedule program for the overall aircraft is one of the biggest problems faced today. It was immediately evident from the discussion that close coordination with engineering, suppliers, and the military is essential in order to expedite the aircraft through its electronics section in the assembly line with a minimum of cost in time, labor, and materials.

Coordination with engineering was suggested to include engineering mockups and functional breadboard systems to be developed concurrently with

engineering design. The need for working out test requirements with the design groups was also emphasized. The engineering departments of at least two airframe companies test both components and complete systems with duplication of the aircraft's wiring, if at all practical.

It was pointed out that continuity checking of wiring systems in the ship is important. It was stated that one company found that 62% of the failures in checking out their systems had been due to faulty wiring. On the other hand, some said that it made little difference, that constant checking of wiring consumed precious time. Another company claimed that 83% of its failures were due, not to wiring or technician error, but to faulty equipment.

The practice of buying or building costly test equipment for preflight checking was questioned because that same equipment could not be used again after installation in the aircraft or during flight tests. The always hot argument of whether electronics equipment should be checked before or after installation in the aircraft was immediately raised with the usual result: the individual aircraft companies will continue to use that method which they have determined through experience is the most efficient and economical for their particular operation.

One important fact seemed to be established. If a failure is caught early enough, it is possible to save far more time and money than if that same failure is not caught until actual flight tests. Flight conditions can be simulated on the ground at small cost compared to actual flight. Then, too, more accurate checks can be made on the ground because trained technicians are looking for specific troubles. A pilot in flight has little time to spend checking equipment. The panel and audience agreed that a man flying a combat mission deserves the assurance that his plane with its many systems checks out before taking off—he won't have time to worry about functional tests.

Again, continuity checks were cited as one means of preventing failures due to faulty technique or equipment.

Another suggestion for reducing elapsed time was to have engineering design a rack on which complete installation and testing of a system could be made, then mount the rack in the aircraft and connect it with the plane's wiring system.

It was agreed unanimously that another time saving factor would be to design accessible installation and testing points into the aircraft itself. Advantage in having such a design feature as a rack is that it permits installation at one place in the line; disadvantages are in weight and size. Small plane installation design seems more difficult than bomber or transport, where there is often room to work.

The problem of whether the design fault is in engineering or production should be shouldered by both. Electronics must be considered in the design of the aircraft, but there is also a definite need for improvements in production methods to permit utilization of new engineering designs. Liaison between these two groups is essential. It is generally handled by production engineering.

Coordination between electronics suppliers and aircraft companies is again important in saving time. If there is more thorough testing by the manufacturer, the aircraft company should capitalize on this time-saver and avoid duplication of testing. There will always be some duplication in testing, but keeping it to a minimum is highly desirable.

A good spares program is also essential. At the present time much equipment, and especially test equipment, is on order for years ahead, with no immediate relief. As a result, aircraft companies improvise their own testing devices, and rather than send equipment back to the supplier and wait for the faulty components to be repaired, they repair the units themselves, all of which is costly and time-consuming. There is the need for an exchange of trained personnel between supplier and aircraft company to familiarize each with the specific problems encountered.

Coordination with the military is also necessary in building up a good spares program to ensure that another piece of equipment is on its way immediately when a failure occurs. Contracts with the military should call for a spares program. It was felt that it is the joint responsibility of the aircraft companies, electronics manufacturers, and the military to keep each other informed of latest developments on specific needs to help reduce elapsed time.

Installation Practices

Installation of electronics equipment in the aircraft presents two basic problems. First, where in the production sequence the installation should occur, and secondly, where the check-outs should occur. Ordinarily, these two questions are dependent upon the complexity of the equipment, size of the aircraft, and company policy regarding the handling of equipment.

Ideally, the complete installation and check-out of equipment are handled at an assigned spot in the assembly line, preferably the last operation before preflight. Some aircraft compaines follow this practice, others spread electronics installation out, the equipment going into the aircraft where convenient along the production line.

Depending on the amount and complexity of equipment, it may require as many as 1000 hr for processing. This includes bench testing, installation, check-out, and flight check time. It was generally accepted, as stated earlier, that both the installation and check-out should be handled by the electronics group. Stations are established along the line where check-outs occur (within the department). Trouble shooting crews can move up and down the line where required to make up time caused by failures in components.

There seems to be a marked trend in the industry at this time to set aside a certain area for exclusive electronics use. It was generally conceded that too much confusion results where there is no specific place in the assembly line for electronics. Installing delicate radar or fire control systems when one's teeth are rattling from the riveter two feet away leaves something to be desired.

In the case of small aircraft, normal practice calls for early installation of that equipment, which

would be almost impossible to install because of inaccessibility by the time the plane reached the electronics department. It was indicated that in all types of planes it was desirable to have wiring and mounts installed before arriving at the department.

The responsibility of who makes the check-out of a system seemed to fall again within the electronics group rather than inspection or quality control because of the specialized nature of the field.

Handling Electronics Equipment

As electronics equipment continues to increase in complexity, it also presents special handling problems. Mishandling can cause failures and, without operational equipment, there can be no operational aircraft.

Since electronics equipment is fragile, extreme care must be exercised when handling it. First of all, the less handling, the better. This applies not only to shipping, testing, and installing but to its actual manufacture as well. Furthermore, the equipment may have to be shipped, stored, and tested many times. Several aircraft companies have proved a definite correlation between excessive handling and a high percentage of failures.

Some very simple and practical techniques may be utilized in reducing the handling of equipment and in applying the correct methods of handling as suggested by the discussion. For example, the use of rubber-tired carts was cited to minimize shocks and jars. Special racks to hold a complete system or component parts will permit testing, adjusting, shipping, storing, and installing. These racks can be sent directly from the manufacturer to the aircraft company. The manufacturer of electronics equipment may find that it is sometimes more expedient to move the technicians along an assembly line rather than moving the equipment.

The field maintenance problem was also discussed. Here, treatment of equipment is often rough, sometimes through necessity, more often through lack of knowledge of the nature of the equipment. This is especially true where equipment is to be shipped back and is improperly packaged. It was pointed out there is a definite need for the military and the manufacturer of electronics equipment to work out a basic program in correct handling. In fact, there is a need to train all those who handle electronics equipment. Various techniques were discussed for training, including on-the-job training by supervisors and formal types of training. Handlers of equipment must be made to realize the important part they play in doing a job right—and that equipment is useless unless in an operable condition. The cost of electronics equipment comes high in money, time, and life, when its failure due to mishandling sends a modern high-speed, high-altitude plane to destruction.

Training

The comparatively new field of aviation electronics has expanded so rapdily that it is suffering an acute shortage of trained personnel. Training personnel for specific jobs and equipment requires long-range planning. The knowledge required is highly advanced and technical, and the training must be on a continuing basis to meet the new types of equipment developed.

From the discussion it was determined that a good electronics training course should contain theoretical discussion of circuit principles, practical experience on operating equipment, and followup on the job. Theoretical instruction can be carried on in the classrooms, in fact, theory in electronics is often considered the practical side. However, to avoid the danger of a technician who can spout long formulas and doesn't know where the switch is, practical experience on operating equipment and test equipment with actual on-the-job training is essential.

The question of who should be responsible for training seems to be dependent on the individual needs of each company. Equipment manufacturers have a specialized product to train for, aircraft manufacturers have one or more integrated systems to train for, and the military has its particular problems. Quite probably, each of these groups is not familiar with the other's problems, so a close liaison and exchange of personnel are highly recommended.

It was suggested that supervisors train personnel on the job, presupposing an already trained staff of supervisors. Specialized technicians would be employed to instruct in classrooms. As far as test equipment goes, it was pointed out that a special group of instrument specialists could be maintained in the aircraft company to ensure correct operation of equipment.

The more complex the equipment, the longer it takes to train a man. It was cited that in the case of one fire control system 200 hr of classroom time were necessary to indoctrinate the students thoroughly. Training Air Force personnel—top-grade technicians with previous experience—takes 25 weeks of intense training on certain radar systems.

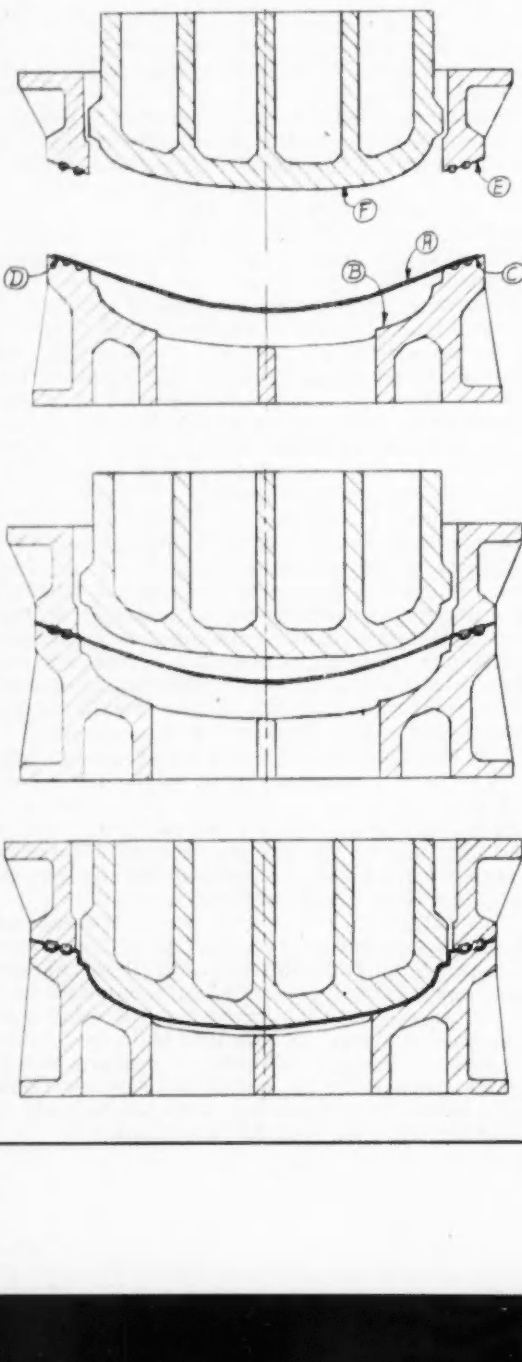
Not all training must be directed in the technician channel. Management should be trained in the basic principles of electronics in order to be familiar with the terminology. With more and more of the total cost of an airplane tied up in electronics equipment, education in the application of electronics manufacturing techniques is necessary. Supervisory personnel must also be similarly trained as well as any group of persons who are connected with the electronics group in manufacturing or assembly. Many companies now hold night classes for these groups, with attendance reported as excellent.

The main purpose of trained personnel is to ensure accurate, competent work with a reduction of cost and time, and, at present, damage to equipment that is still scarce. One company has successfully placed women on assembly work of a technician level and succeeded in reducing production time from six to three days.

The future of electronics demands long-range planning and one of the chief problems still unanswered is whether to train aircraft mechanics in electronics or train electronics technicians in the principles of aircraft. Experience has proved that it is easier and more practical to train the electronics man in aircraft techniques. Perhaps it is desirable to set aside the electronics man in aviation as a specialized technician with an entirely new name for the field such as "aerotronics."

What Makes Body Parts

Dies for automobile bodies should permit economical fabrication of high quality parts. To attain this end, wholesale cooperation between body and die engineers is essential. Frequently, for example, a small change in a part will make it easier to draw, permit use of less expensive presses, dies, and steel, and insure a better quality of panel. How are large body panels drawn from flat sheet steel? What conditions affect the ease of drawing such panels? We will see . . .



1. ROOF panels are comparatively easy to draw, since there are no sharp pockets or sudden changes in panel depth. They cannot be formed complete in a draw die, however, for die action is vertical and back draft conditions cannot be produced.

First, a steel blank (A) is loaded on the lower die member (B). There it rests on binder surfaces at C and D, sagging across the intervening space.

Then, the upper binder ring (E), which operates independently of punch F, moves down—squeezing the blank between the washboard-like surface.

Next, as this ring of grooves restrains inward movement of metal, punch F is brought down—forcing the blank into the shape of the roof panel.

The front window shape is then formed by a bottom punch which makes its upward stroke after the upper punch has formed the rest of the panel. A trim and a flange die complete the job.

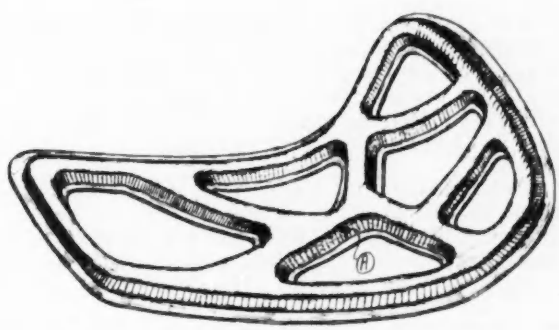
The developed trim line is shown at G. All metal outside of it is scrap. Binder scrap in a sense does not cost anything, since it is all stretch.

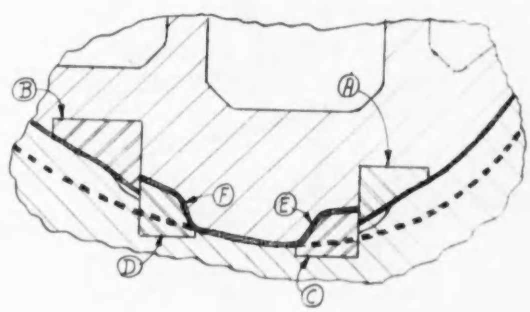
Whether a certain roof panel can be drawn depends on whether there is enough latitude between the lightest binder pressure which will not permit wrinkles and the heaviest binder pressure which will not cause the blank to tear.

Hard to Draw . . .

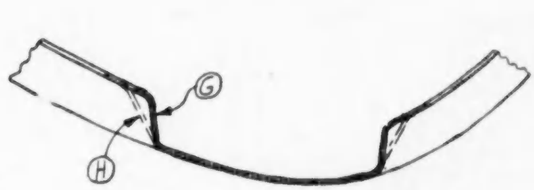
Charles R. Cory, Fisher Body Division, General Motors Corp.

Based on paper, "Design of Dies for Auto Bodies" presented at SAE Detroit Section Meeting, Feb. 18, 1952. Complete paper is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.



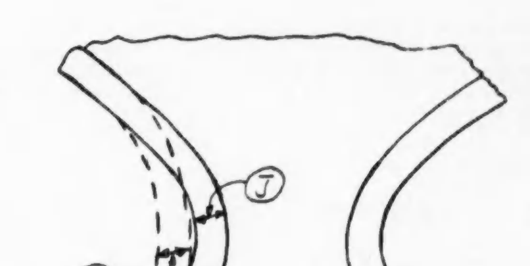


2. DECK LID panels are more difficult to draw because of the number of deep depressions. Extra metal to form the wall at A, for example, must come mainly from the edge of the panel. And it must travel through pretty hilly country to get there.



So far nobody has been able to work out a formula which tells (1) how deep and steep walls of the pockets or depressions can be or (2) how small the plan view radius of corners of depressions can be. Experience with previous panels is a rough criterion. But the final decision must come from tryout men who have to make the die work.

Occasionally, shear steels must be added at certain locations to reduce tearing. These shear steels (A and B), in shearing past the lower steels (C and D), shear openings in the future lightening holes. The extra metal required to form the walls of depressions E and F can then pull partly from this sheared opening rather than entirely from the outside binder surface.



If panels still tear after the radii have been made large enough to rule out sharpness of corners as a special factor in tearing, depression walls, G, may have to be tapered to less steepness. As an alternate, the plan view radius of the depression could be increased from J to K.

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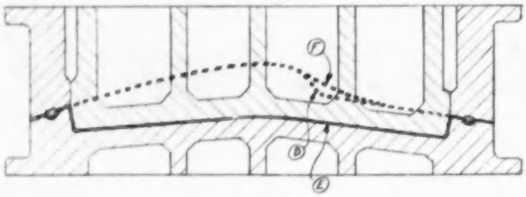
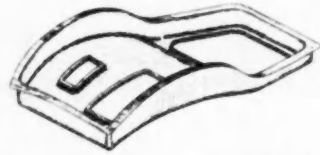
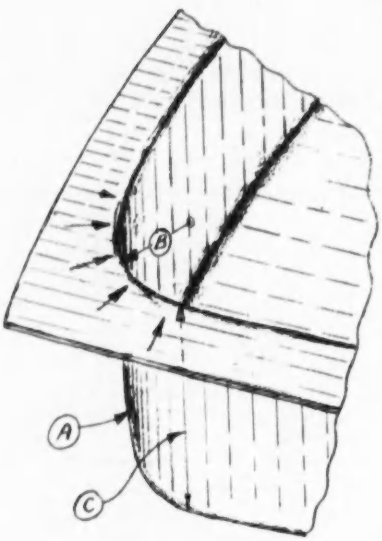






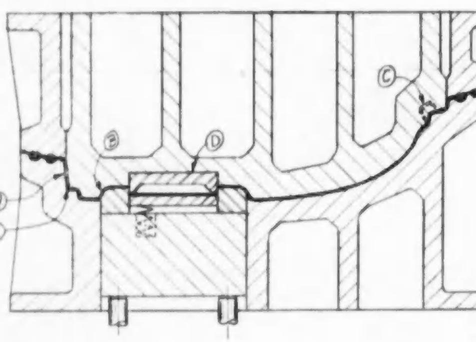
3. DOOR INNER PANELS

fall in the critical-parts-to-draw category. That's because depth of these panels is so great compared to the relatively small plan view radii of the sill corners.

Metal pulling in from the binder surface at the sill corners tends to crowd together as indicated by the arrows. Therefore, there must be a great deal of binder pressure to stretch the metal enough to prevent wrinkles from forming in the wall at A. If plan view radius B is too small for panel depth C, tears are inevitable. In this case, a separate facing panel must be used.

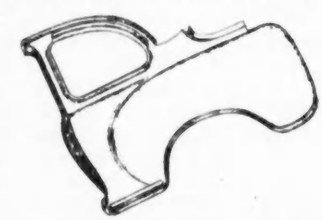
The outside or hem flange serves as the binder surface except under the region where flange line D, being too steep, would make a poor binder line. It would be considerably longer than punch line E, and would result in excess metal. Thus the binder line at that location is straightened out as shown by line F.

Theoretically the binder line is still incorrect, since its length exceeds that of the punch line. However, the great depth of the side walls takes up any slack caused by excessive length of the binder line.



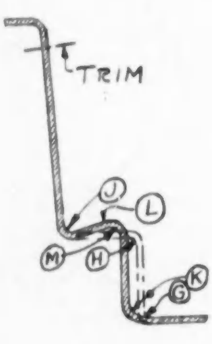
4. REAR QUARTER PANELS

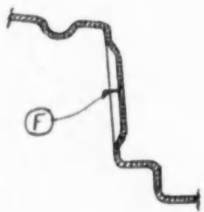
present drawing problems too. A sectional view of one in a rear quarter panel die will serve to illustrate some of them. The main shape of this panel is formed by the upper punch pulling metal in and down from the binder surface. Then the window is shaped by the bottom punch moving upward. Shear steel (D) partially trims out the scrap inside the window opening. This permits needed metal to move outward from the shear line to form part of the window.



The door facing wall (A) tends to have waves of loose metal. That's because it is drawn from break line E which has a contour of considerable sweep. Usually it is necessary to add small depressions (F) in the facing to absorb this excess metal. These depressions, which are formed later in another die, also stiffen the facing and improve panel quality.

Still another problem is presented by the sharp door offset radii G, H, and J. They are difficult to form without tearing the metal. These corners, therefore, must be drawn with larger radii, then spanked sharp in a later operation. Thus, the door offset wall is drawn ⅛ in. out of position, giving a larger radius at K . . . and offset L is tipped, giving a larger radius at M.





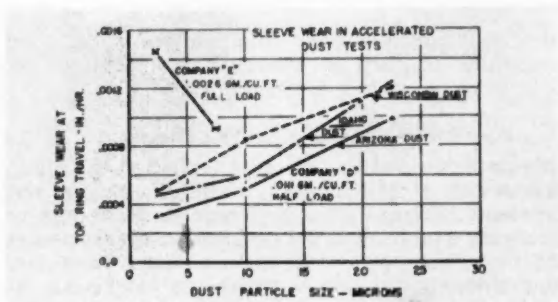
Air Cleaning

Engines just can't digest dust . . . and it's up to air-cleaning systems to keep these abrasive particles out. What factors make this job difficult? What steps can be taken to improve efficiency of air-cleaning systems? These questions were answered at the symposium on Progress in Engine Protection by Air Cleaning held at the SAE National Tractor Meeting, Milwaukee, Sept. 10, 1952.

Authors of three papers noted that dust concentration, particle size, and engine load are all-important . . . then suggested that air-cleaning efficiency could be improved by:

1. Using combinations of precleaners, oil-bath air cleaners, and aftercleaners in series.

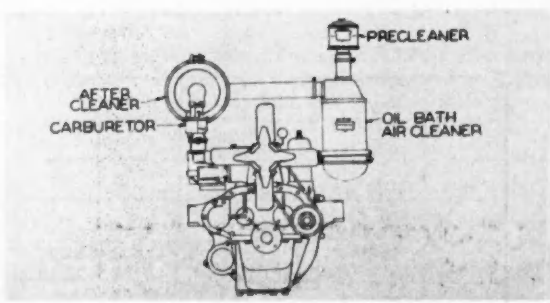
2. Locating the inlet to the air-cleaning system at a point of minimum dust concentration.



E. S. Dahl and K. H. Rhodes

Massey-Harris Co.

. . . set the stage for ensuing discussion in their paper entitled, "Dust and Engine Wear." They detailed the affect that dust concentration, particle size, and engine load can have on engine wear. An extensive abridgment of this paper appears in this issue beginning on page 42



David P. Eastman

United Specialties Co.

. . . reported on "New Methods of Securing Improved Air Cleaner Efficiency." Engines need not swallow so much dust, said this engineer. Coupling combinations of precleaners, oil-bath air cleaners, and aftercleaners in series can reduce dust flow to engines up to 73%. An extensive abridgment of this paper appears in this issue beginning on page 44

Robert E. Larson

Donaldson Co., Inc.

. . . emphasized "Advantages of a Well-Chosen Air Cleaner System." Field tests show that locating the air cleaner inlet in a high position at the extreme front of a tractor is a good way to reduce dust inhaled by the engine, he reported. An extensive abridgment of this paper appears in this issue beginning on page 46

Dust Is Hard to Digest

Every gram of dust an engine has to swallow does considerable damage . . . Just how much depends on particle size, dust concentration, and engine load.

E. S. Dahl and K. H. Rhodes, Massey-Harris Co.

Based on paper, "Dust and Engine Wear" presented at SAE National Tractor Meeting, Milwaukee, Sept. 10, 1952.

EVERYTHING possible must be done to keep dust out of engines. Regardless of particle size or engine operating conditions, every gram of dust an engine has to swallow does considerable damage. Just how much damage will be done in any particular engine depends largely on these three factors:

- Dust concentration in intake air
- Particle size
- Engine load

To permit study of the effect of these individual factors, tractor and engine manufacturers were asked to supply laboratory and field test data. Five companies provided engine wear data obtained on 67 tractors or engines of several sizes.

Double Dust Rate Doubles Damage

Tests performed by Company E showed the effect of dust concentration in engine intake air. It fed the same amount of 0 to 5 micron particle dust to an engine operating at maximum load over a period of 5 hr in one test and 53 hr in another. Result—approximately twice as much sleeve wear occurred at the top of piston ring travel when the same

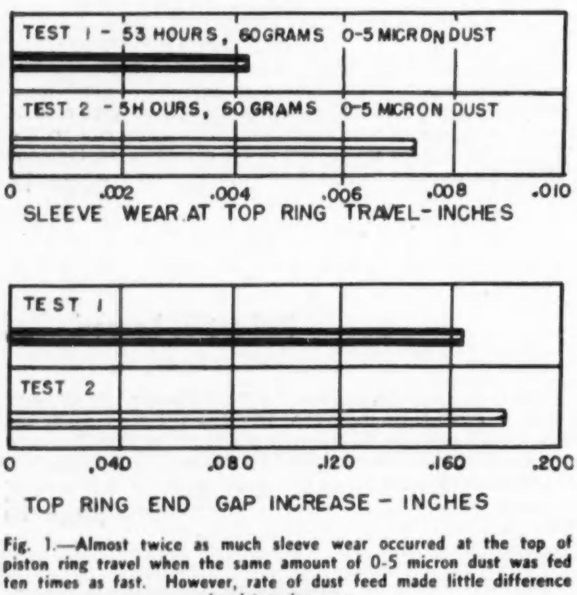


Fig. 1.—Almost twice as much sleeve wear occurred at the top of piston ring travel when the same amount of 0-5 micron dust was fed ten times as fast. However, rate of dust feed made little difference in piston ring wear

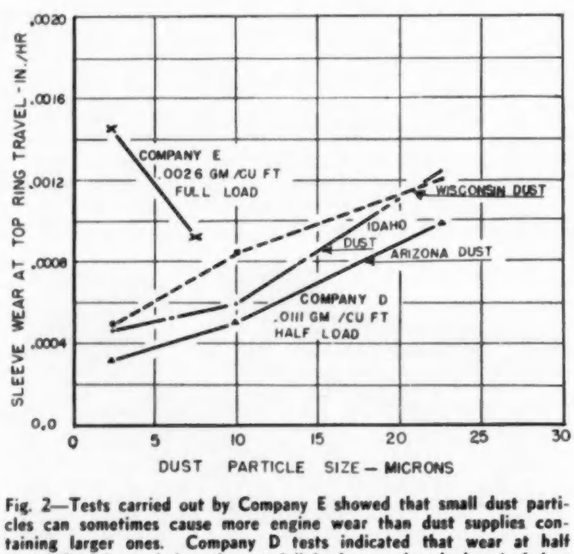


Fig. 2—Tests carried out by Company E showed that small dust particles can sometimes cause more engine wear than dust supplies containing larger ones. Company D tests indicated that wear at half engine load is much less than at full load even though dust is fed at a faster rate

amount of dust was fed at the higher rate. (See Fig. 1.) Little difference was observed, however, in the amount of piston ring wear.

Other tests conducted by Company E and Company D showed that dust of small particle size is not necessarily harmless to engines.

Company D ran separate tests with the following dust supplies:

Wisconsin field dust
Idaho field dust
Arizona field dust

Each of these were graded into 0 to 5, 5 to 15, and 15 to 30 micron particle sizes. Tests were carried out at 50% engine load with a dust concentration of 0.0111 g per cu ft of air taken into the engine.

It was found that the largest particle size dust wore the cylinder bores at the top of ring travel 2½ times—and the piston rings 3½ times—faster than the smallest particle size dust. (See Fig. 2.)

Small Particles Bad, Too

However, tests carried out by Company E showed that small dust particles can have a deleterious effect on engines, too. In these tests, engines of basically the same type and size as those used by Company D were run at full load with a dust concentration of 0.0026 g per cu ft.

As shown in Fig. 2, fine 0 to 5 micron dust gave 50% more wear than A-C Fine dust, which consisted of almost half, by weight, 10 to 40 micron particles. (To show the relationship on the curve, the A-C Fine dust point has been placed arbitrarily at a hypothetical mean of the particle size of this type of dust. Admittedly, therefore, any value taken on the line joining these two points is not a true value.)

In short, these tests show that other factors must be carefully considered before drawing the conclusion that dust of small particle size is unimportant in engine wear.

Engine Load Makes a Big Difference

One factor that should not be overlooked is engine load. There are many clear indications that it is one of the most important variables in determining engine wear.

For that matter, the test results shown in Fig. 2 give some evidence of this. Engine wear obtained by Company E on an engine run at full load was more than three times as much as that obtained by Company D on a similar engine operated at 50% load. (In both cases, the engines were forced to swallow 0 to 5 micron dust particles.) And this was true despite the fact that dust was fed at a faster rate to the engine operated at 50% load.

To be sure, it's true that the results of these two tests alone are not sufficient to show the relationship between engine wear and engine load. However, they are cited to show that wear results from one test at a certain engine load should not be compared arbitrarily with results of another test carried out at a different per cent of maximum load.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Based on Discussion

By B. Gratz Brown,
Fram Corp.

EFFICIENCY should not be the sole criterion for judging air cleaners. More emphasis should be placed on the size of particles that pass through a cleaner. An air cleaner with 97% efficiency which removes all but very finest particles may protect an engine better than one with 98% efficiency which allows some larger particles to reach the engine.

To illustrate, Fig. A shows results of two wear tests made on 6-cyl, 100 hp engines. Each engine was run at wide-open-throttle on an engine test stand, with carburetor intake protected by an absolute filter. Every 15 min one gram of dust was blown into the throat of the carburetor. In one case, the dust was 0-5 microns in size; in the other, 5-10 micron dust was used. Engine condition at the end of 25 hr is indicated by increased blowby and wear of the rings, bores, and bearings.

For an overall average, it might be said that 5-10 micron dust causes twice as much wear as 0-5 micron dust. Still greater wear would be experienced with 0-10 micron dust. And rate of wear with larger sizes of dust would be very severe.

Therefore, we should be as much concerned with size of dust reaching an engine as we are with quantity of dust. This is especially important now that air cleaner efficiencies are so high that a small change in efficiency makes a big percentage difference in the amount of dust entering an engine.

DUST SIZE – MICRONS	0–5	5–10
BLOWBY INCREASE – CFM	2.8	7.0
RING GAP INCREASE		
TOP COMPRESSION	.142	.312
2nd COMPRESSION	.064	.173
1st OIL	.112	.188
2nd OIL	.086	.166
CYLINDER BORE DIA. INCREASE		
TOP TRAVEL – TOP RING	.0054	.0108
– BOT. RING	.0027	.0076
CENTER TRAVEL	.0018	.0050
BOT. TRAVEL – TOP RING	.0004	.0018
– BOT. RING	.0002	.0010
BEARING WEIGHT LOSS – GRAMS		
RODS	.089	.210
MAINS	.183	.395

Fig. A—This shows the engine wear that occurred in 6-cyl, 100 hp engines when 0-5 and 5-10 micron dust was blown into the carburetor throat every 15 min for 25 hr. (Equivalent to an air cleaner efficiency of 98.2%)

Engines Need Not Swallow

David P. Eastman, United Specialties Co.

Based on paper, "New Methods of Securing Improved Air Cleaner Efficiency" presented at SAE National Tractor Meeting, Milwaukee, Sept. 10, 1952.

UNTIL such time as new and better air cleaners are perfected, improvements in air cleaning systems should stem from combinations of the three well-known filtering devices. Combinations of precleaners, oil-bath air cleaners, and aftercleaners in series really do a superior dust-removing job.

How Three Types Work

Each of these three types of air cleaners works on a different principle.

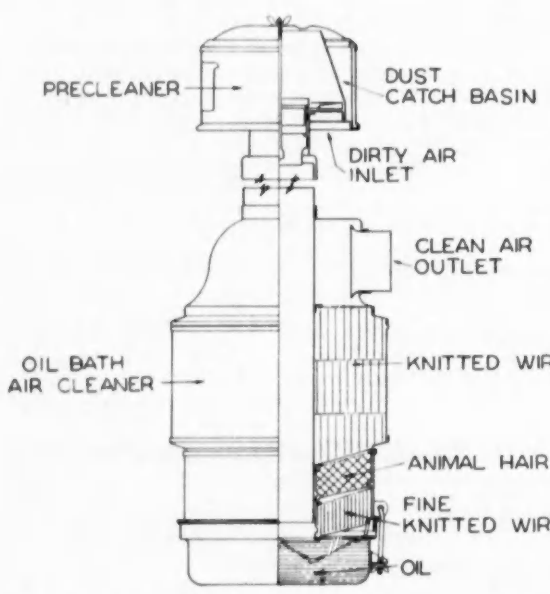


Fig. 1—A precleaner helps take some of the dust-removing load off oil-bath air cleaners

The oil-bath air cleaner operates on the oil-bath or oil-washed principle. It first presents a liquid pool of oil to the air stream, then a mass of wire or fibrous material uniformly packed with ample porosity for movement of oil, air, and foreign material.

Its advantages are relatively high cleaning efficiency coupled with good dust-holding capacity, and ease with which it can be repeatedly cleaned.

Precleaners work on the so-called inertia principle. With this device, dust is separated from the air stream by inertia. The most common form is the centrifugal precleaner in which the air stream is forced into rapid rotational movement, and foreign matter—unable to follow the path of the air—is cast out into a trapping chamber. Such a precleaner is shown in Fig. 1, mounted on the intake stack of an oil-bath air cleaner.

This type of air cleaner is barred from a position as a primary means for cleaning engine air because of inherent low efficiency. But it can play an important role in protecting an oil-bath air cleaner from the bulk of incoming dust load.

Aftercleaners work on a third principle which calls for actually straining foreign matter out of the air stream with a porous wall. An aftercleaner is so-named because it performs a secondary clean-

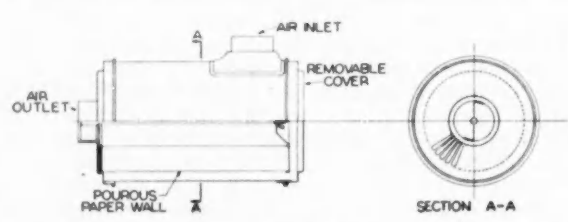


Fig. 2—An aftercleaner contains a porous paper wall that strains dust from the air stream

So Much Dust . . .

. . . Coupling combinations of precleaners, oil-bath air cleaners, and aftercleaners in series can reduce dust flow to engines up to 73% . . . And this improved protection can be obtained without reducing dust-holding capacity of conventional oil-bath air cleaner installations.

ing operation following action of the oil-bath air cleaner.

Porous-wall filtering elements used in aftercleaners are made from heavy, treated filter paper. Long sheets are pleated, then shaped into cylinders. These, in turn, are wrapped around a supporting perforated steel center tube. The filter is placed in a sheet metal enclosure provided with an air inlet and outlet. (See Fig. 2.)

In general, if aftercleaners are built with pores fine enough for adequate protection of an engine, their dust-holding capacity is relatively low. Another disadvantage is that porous-wall cleaners do not lend themselves to subsequent cleaning and re-use.

None the less, these devices can perform a service in tractors and heavy machinery when combined with other equipment capable of protecting them from excessive dust loads.

Why Combinations?

In short, by coupling combinations of the three basic types of air cleaners in series, each unit can contribute its own particular feature to an air cleaning system.

Using a precleaner with the oil-bath air cleaner shown in Fig. 2, for example, cut by 61% the dust that would have entered an engine protected only by a standard commercial oil-bath air cleaner. (The oil-bath air cleaner in Fig. 2 has a special pack.) The cleaning effectiveness of this combination was 99.63%, as compared to 99.04% for the standard oil-bath air cleaner.

It is an odd fact, however, that addition of a precleaner to a standard oil-bath air cleaner results in an overall efficiency less than that of the oil-bath cleaner. Only through recognition of the oil-bath cleaner as a single component in a two-stage cleaning system can improved results be obtained. The filter of the oil-bath cleaner must be adjusted to fit the special requirements of the combination. With this approach, a system can be produced with (1) the efficiency of the conventional oil-bath air cleaner but with a longer service-free operating period, (2) an equal service period coupled with much higher cleaning efficiency, or (3) any compromise between these two conditions.

A combination of an oil-bath air cleaner and an aftercleaner can pay big dividends, too. Using a porous-wall aftercleaner with a standard oil-bath air cleaner made it possible to reduce dust flow to the test engine by 64%. System efficiency was 99.66%, as compared to 99.04% for the oil-bath cleaner alone. In this combination, the oil-bath cleaner establishes the dust-holding capacity of the system, and the aftercleaner contributes to the extremely high system efficiency.

Coupling a precleaner, oil-bath air cleaner, and aftercleaner in series can also be fruitful. A system containing these three elements eliminated 73% of the dust that would have entered an engine protected only by a conventional oil-bath air cleaner. (This combination gave a system efficiency of 99.74%.) What's more, this improvement in engine protection was accomplished without reducing the service-free period of the oil-bath air cleaner.

There are many tractors and machines now in service under heavy dust conditions which, due to space limitations, do not lend themselves to use of three or even two stages of air cleaning. However, where there is a need for greater air cleaner efficiency, consideration should be given in initial design stages to providing space for combination air cleaner systems.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Inhaling Cleaner Air Takes

MORE engine-killing dust must be kept out of tractor engines . . . and locating the air cleaner inlet in a high position at the extreme front of a tractor will help.

The rate at which dust enters an engine is a function of dust concentration at the air cleaner inlet and efficiency of the air-cleaning system. The ideal system quite naturally would include a cleaner of 100% efficiency or an inlet position of zero dust concentration. Since neither exists, a practical approach would be to locate the air cleaner inlet at the point of minimum dust concentration.

Recently tests were made in the Phoenix, Arizona area to determine this point. Nineteen separate positions were investigated—some as possible production locations, others strictly for comparison as to their relative dust pickup. (See Fig. 1.)

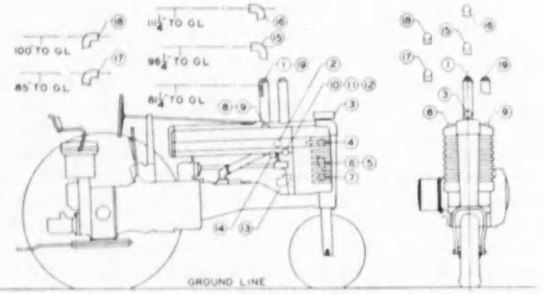


Fig. 1—Dust concentration at 19 different points on a tractor was investigated to determine the best position for the air cleaner inlet

1—Base line on production location
2—Left side flush with hood
3—As shown
4—Horizontal tube ends and rear open
5—Vertical duct rear open
6—Vertical duct end mitered
7—Horizontal tube ends and rear open
8—As shown
9—As shown
10—Horizontal tube both sides open
11—Same as 10 except left side only open
12—Same as 10 except right side only open
13—As shown on left side of tractor
14—Behind baffle open at tractor centerline
15—As shown
16—As shown
17—Position of operator's mouth when seated
18—Position of operator's mouth when standing
19—Seven inches to left of base line

Limitations of test equipment did not permit simultaneous investigations of all 19 positions. Instead comparative data were obtained by running groups of four, always using the standard production inlet location as a reference point. (Point 1.) Dust pickup at this point was considered unity, and pickup rates at the other positions were rated accordingly.

Several sets of data were taken at each position with the test equipment tracing a rectangular course to minimize the effect of wind velocity and direction. Table 1 shows the test data accumulated. In summary, it shows that:

- Dust pickup at an elevation 114¼ in. above ground level (16) was 15% less than at 96¼ in. (15); 55% less than at 81¼ in. (standard production inlet location); and 206% less than at 64 in. or hood level (8 and 9).
- At hood level, dust pickup at a forward position (3) was 47% less than at a position 30 in. to the rear (8 and 9).
- Combining the effect of elevation and forward position, dust pickup up front at hood level (3) was only 10% more than at a position 31½ in. higher (18).

An air inlet location remote from the air cleaner —drawing air from a relatively clean position— might appear then to be the answer. Unfortunately, however, ducting of air from a remote position requires use of bends and/or elbows . . . and these interfere with free flow of air to the cleaner. This, in turn, cuts air cleaner efficiency.

The effect of single and double 90 deg smooth bore elbows on air cleaner efficiency has been determined by field investigation. Results of this investigation, together with dimensional information on the elbows, are shown in Fig. 2.

As a further illustration, several farm and industrial tractors now in production use ducts to avoid installation interferences or to eliminate the vertical inlet stack. One such inlet system consisting of a formed metal tube and a cast elbow with a backfire trap was found to pass 212% more dust to the engine than did a straight-through inlet. Another system with two 90 deg cast elbows showed a loss of 69% in cleaning efficiency as compared to a system with a straight-through inlet.

Summing up then, reduction in dust pickup rate by more advantageous location of the air cleaner

Load Off Air Cleaners

More engine-killing dust can be kept out of tractor engines . . . if inlets to air cleaners are located in high position, up front. They must have no bends and elbows, too.

Robert E. Larson, Donaldson Co., Inc.

Based on paper "Advantages of a Well-Chosen Air Cleaner System" presented at SAE National Tractor Meeting, Milwaukee, Sept. 10, 1952.

inlet should offer a corresponding reduction in rate of wear. If, however, reduction in dust pickup rate is accomplished at a sacrifice of air cleaner efficiency, this advantage is diminished and may be lost. It is difficult, if not impossible, to anticipate the extent of dust deagglomeration in an inlet duct. With several possible inlet locations, dust pickup rate and air cleaner efficiency at each position should be weighed carefully.

In short, it's not just coincidental that radiators are located at the front of a tractor; controls located within easy reach of the operator; and the drawbar located at the rear. Why then isn't it natural for the air cleaner to be located at an extreme forward position and be equipped with a straight-through extended inlet?

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

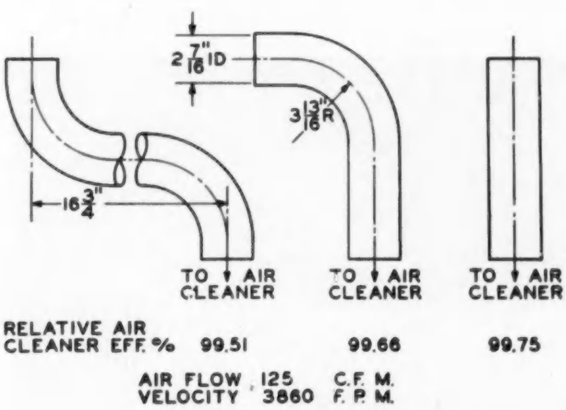


Fig. 2—Elbows in the air cleaner inlet reduce air-cleaning efficiency of the system

Table 1—Dust Concentration at Various Positions

Position	Dirt Pick-up Ratio[1]	Dirt Concentration g per 100 cu ft
1	1.000	0.1428
2	1.858	0.3834
3	1.038	0.1476
4	1.101	0.1366
5	1.167	0.1631
6	1.604	0.2338
7	5.840	0.3993
8	1.984	0.2385
9	1.964	0.2847
10	3.768	0.4599
11	5.643	0.6070
12	1.766	0.2095
13	3.714	0.2771
14	2.989	0.4290
15	0.741	0.1364
16	0.644	0.0931
17	1.735	0.2771
18	0.944	0.1329
19	0.974	0.1478

[1] Based on position 1 as unity.

Modern Trailer Features

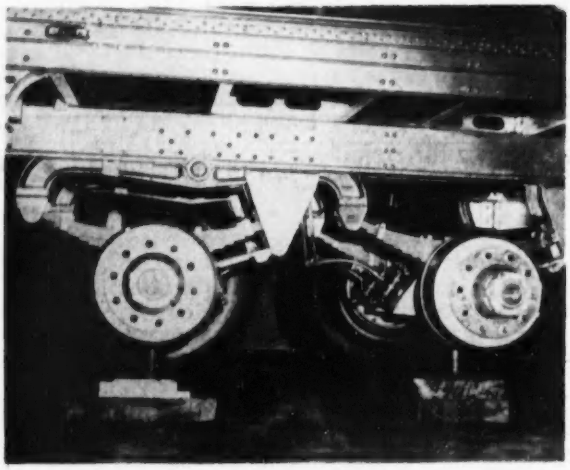


Fig. 1—An all-aluminum tandem axle truck trailer suspension which requires no lubrication. Large aluminum equalizer beam is pivoted on rubber. Heat treated aluminum spring hanger castings have aluminum sprayed cast steel spring pockets cast integrally

THE old sheet metal covered, wood framed, trailer which required continual repair and disintegrated in the event of an accident, is rapidly disappearing from the highways, to be replaced with all aluminum units into which extra strength has been designed to protect the lives of driver and motoring public should freight shift because of collision or rapid deceleration.

One manufacturer provides as standard equipment, turn and directional signals conforming to SAE recommendations, also electrical wiring in rigid metal conduit with each circuit color coded and individually fused. Because electrical failures seem to occur most frequently when trailers are loaded, externally exposed junction boxes are provided, having removable covers to permit complete removal and replacement of any wiring when the trailer is fully loaded and doors sealed.

Single and tandem axle suspensions requiring no maintenance or lubrication other than normal tire service and brake relining, are another feature

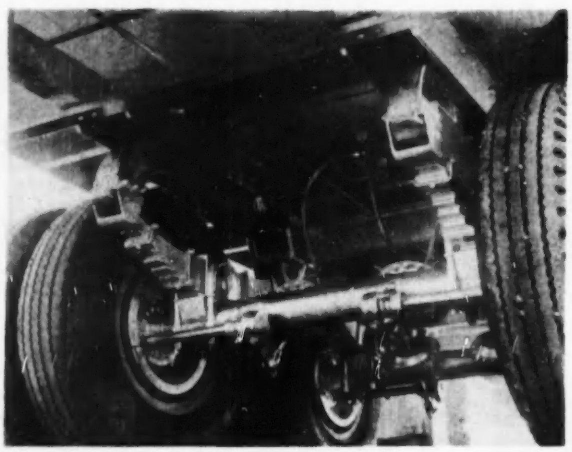


Fig. 2—Inverted U-bolt design prevents flattening of bolt where it makes line contact with axle tube in conventional design. Note brake slack adjusters are outboard of both axle tubes to give accessibility for adjustment and shortest matched brake hose length

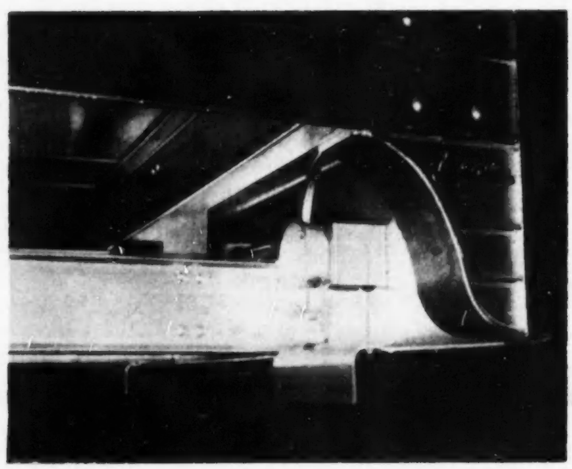


Fig. 3—Electrical wiring to turn signals and tail lights is enclosed in conduit to prevent road failures from ice accumulation or flying debris

Low Weight, Low Maintenance

K. W. Tantlinger, Brown Trailers, Inc.

Based on paper, "The Modern Truck Trailer" presented at SAE Northern California Section, San Francisco, on Sept. 24, 1952.

of the modern trailer. Radius rods are bushed with low cost and easily replaced rubber bushings having a life expectancy of over 250,000 miles. Load equalization between tandem axles is achieved by a heat-treated cast aluminum equalizer beam, having replaceable steel tips. The beam is pivoted on a large rubber bushed trunnion bearing and rotates through an angular movement of only 13 deg, hence the bushing life can only be estimated. Bushings in continuous service for over two years show no sign of use or deterioration.

Extruded aluminum floors, flat surfaced for general freight or ribbed for ventilation under refrigerated loads, are available as standard equipment. These replace the old heavy and water soaked wooden floors which harbor bacteria and odors. Extruded aluminum plank requires no attention, retains its strength permanently, and is 25% lighter than wooden flooring.

Loosening or stretching of U-bolts used to be a common maintenance problem despite the use of larger diameter bolts and heat treatment. It was observed that bolts which had stretched were flattened slightly at their inner surface where they wrapped around the axle. This tendency to flatten has now been eliminated by inverting the bolt, cradling it in a concave spring saddle, and providing a cast steel cap beneath the axle. After the initial tightening and after the scale has worked out from between the leaves and the leaves have seated against themselves, there is no longer any working loose or stretching.

In designing to reduce maintenance or to make necessary maintenance as simple as possible, axles have been reversed on tandems to locate slack adjusters outside the axles so that drivers can take up brakes without soiling their uniforms. Door hinge bearings have tough plastic thrust washers which never require lubrication. Earlier designs rarely got lubrication and when they did, over-lubrication caused the oil to run down the rear of the trailer to collect dust. The loose liner fastener problem has also been solved. Constant vibration has always made it difficult to attach the liners in both insulated and dry freight trailers and loose liner screws were a common evil. Now drive pin rivets are used to secure both plywood and aluminum liners to metal or wood.

Retaining an adequate seal or closure at the rear

Semitrailer Weight Can Be Cut

BODY weight reduction has almost reached its limit. From now on gains will have to come from lightening the running gear. Here are four ways to cut the weight of a 30 ft tandem axle semitrailer to save approximately 24% in running gear weight and 14% in total trailer weight.

Use magnesium for brake shoes, hubs and brake spiders	250 lb
Replace conventional wheels with forged aluminum discs	256
Use co-axial rubber springs	312
Substitute corrugated wrought aluminum sheet for extruded aluminum plank floors	380
	1198 lb

doors has always been a problem. Although the torsional rigidity of a semi-monocoque trailer prevents the rear frame or door jamb from racking, rear doors with conventional seals located against the rear face of the jamb quickly abrade. The abrasion is caused by relative movement between doors and door frame which could not be prevented with compression type flat seals oriented in a single plane. To stop the movement a wedge type door and frame construction was designed. Using a hollow 63S-T6 aluminum extrusion of trapezoidal cross section with two integrally extruded "T" slots along one of the tapered faces to secure replaceable rubber seals, a light wedge type door was designed. Attachment of the flat skin sheet across the open side of these extrusions turns them into closed sections having exceptional torsional rigidity. The doors "plug into" rather than lie against the matched taper of the rear frame or door jamb. Relative movement is eliminated since the doors, tooled to provide interchangeability, fit like a cork in a bottle.

The transverse box members which support the king pin of a semitrailer are sometimes subject to fatigue. These members were welded from shallow channels with the welds at the top and bottom of the member. Now, by forming the members from two channels welded at the center of the sides or neutral axis, fatigue failures have been eliminated.

By themselves, the wheels, tires and axles of a tandem axle semitrailer weigh more than the completely insulated and lined body. A fully insulated van trailer body, with floor strong enough to withstand the heaviest power loading, weighs approximately 100 lb per linear ft. Further weight reduction is possible but the point of diminishing return is approaching. In the future, weight savings must come from the running gear. Experimental work now in progress indicates that 35 ft tandem axle van trailers which do not exceed 7500 lb are not improbable. Generally speaking, a reduction of one pound in weight permits an increase of $1.00 per year in profit with any trailer hauling capacity payloads. Therefore, a well designed light weight modern trailer can pay for itself out of added revenue in about two years of operation.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.)

Excerpts from Discussion

Ernest Starkman, University of California:

Have you had any difficulties with packing of the Fiberglas insulation?

Tantlinger:

No. We formerly used cotton packing. This eventually picked up moisture which would dissolve the fire-retardent salts present and corrode the aluminum.

Don Carrington, Blankenship Motors:

Have you made vans with tail gates?

Tantlinger:

Yes, but if aluminum is to be used here, it must be welded, which offers more difficulties in manufacture.

Sydney B. Shaw, Pacific Gas & Electric Co:

Why don't you use light weight honeycomb type sections and cemented joints?

Tantlinger:

This type of construction is used by aircraft companies for certain military projects where price is not the main object. The honeycomb sections would be harder to maintain commercially, and the cemented joints are not competitive due to the heat, pressure and cleaning required.

J. V. De Camp, Norton Truck Co:

Are corrugated skins always used in this construction?

Tantlinger:

We have found them to be best. It's fundamental that the skin be stressed to obtain the needed strength. Since the floor load must be taken entirely by the skin sheet, the spacing of the first corrugation or bead from the floor joint is critical to avoid the developemnt of fatigue cracks.

R. W. Goodale, Standard Oil Co. of California:

How is it possible to avoid lubrication of the shackles?

Tantlinger:

Use of the Torsilastic spring (B. F. Goodrich) with bushing pivoted on coaxial rubber has been very successful and needs no lubrication. The spring constant builds up with the load, giving a good ride and stability. This type is used in military tank trucks and also in Twin Coaches.

Operational Problems of the Transport Helicopter

F. N. Piasecki and L. S. Wigdortchik, Piasecki Helicopter Corp.

Excerpts from paper, "Can the Airlines Use the Helicopter?", presented at the SAE National Aeronautic Meeting, Los Angeles, Oct. 3, 1952. This paper will be published in full in the 1953 SAE Transactions.

MULTIENGINE helicopters suitable for airline service can be available for airline service from 1956. For block distances up to 350 miles these helicopters will be able to offer the intercity traveler a service superior to that now obtainable with airplanes.

By complementing the operation of the trunk line airplane, the short haul transport helicopter will accelerate the growth of all air traffic by bringing air travel to a much greater number of communities and people. It will also help to alleviate many of the problems of airports and airplane operation.

Before helicopter transport services can become a reality, however, practical operational research will have to be conducted to establish the requirements and operating techniques of the airlines so that they may be incorporated in these helicopters.

Presented here is a discussion of eight of the operational problems to be solved:

1. All-weather flight problem.
2. Partial-power safety and take-off area requirements.
3. Arrangement of passenger accommodations.
4. Traffic and ground handling techniques.
5. Integration of airplane and helicopter operations.
6. Noise.
7. Some problems of heliport design.
8. Local community flight ordinance standardization.

All-Weather Flight Problem

Helicopters are currently operating scheduled routes in the United States under contact conditions of 300-ft ceiling and ½-mile visibility, that is, well below airplane IFR minimums. Early experimental work has already proved that there is no fundamental reason why the helicopter will not eventually be able to operate under lower IFR minimums than the airplane. But only the fringes of the practical problems have been tackled and a considerable amount of work is required to bring all of the techniques and aids to a high standard of practicality. The air Navigation and Development Board has recognized this and is proposing an

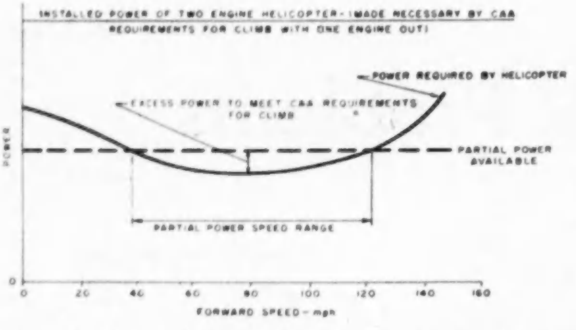


Fig. 1—Partial-power flight speed range for conventional multiengine helicopter

experimental flying program to establish techniques and to provide equipment that will permit the all-weather operation of helicopters. Among the aspects which have to be clarified are:

1. Blind flight: Several operating agencies have shown that existing helicopters with various stability and control characteristics can be flown under completely blind conditions, provided that there is adequate instrumentation. Limited IFR certification has been granted in two cases. However, the problem is one of endurance, for pilots tire easily and it is not believed that such helicopters should be flown blind over one hour. Automatic pilots are already being installed in production helicopters which solve this problem, but emergency techniques for autopilot "safe" failure are not completely established. Minimum stability and control requirements need to be specified for manual flight. New altitude and low-speed indicators need to be developed for approach flight. Considerable experience needs to be amassed on such new equipment in order that blind flight may be developed into an everyday art.

2. Air traffic control rules and operating altitudes: Helicopters should be operated at low altitudes, 500 to 2,000 ft above the terrain, where they do not encounter the highest winds. Helicopters should be confined to a separate traffic pattern en route and also when connecting with airplanes at airports. New traffic rules will have to be formulated to avoid en route flight delay while techniques to avoid conflicting with airplane traffic patterns at airports must be proved.

3. Navigation aids: Present-day radio navigation systems in the United States are VHF with line-of-sight limitations, in that the signal cannot always be picked up over low terrain, behind hills, or in the lee of city buildings. Helicopters, operating at low altitudes, require an accurate indication of their track and direction, and so considerable modification of existing aids may be necessary. The accuracy of the navigation aid should be sufficient to bring the helicopter into the range of the approach aid.

4. Approach and take-off aids and ground lighting: Helicopters could be operated either with GCA or ILS, but the cost would be prohibitive for the heliports that will develop in small towns. The slow approach speed of the helicopter gives the pilot more time for recognition and correction. Less elaborate equipment should be adequate, and this might take the form of an unmanned radio beacon which transmits an approach cone based on the optimum angle of approach. Approach direction can

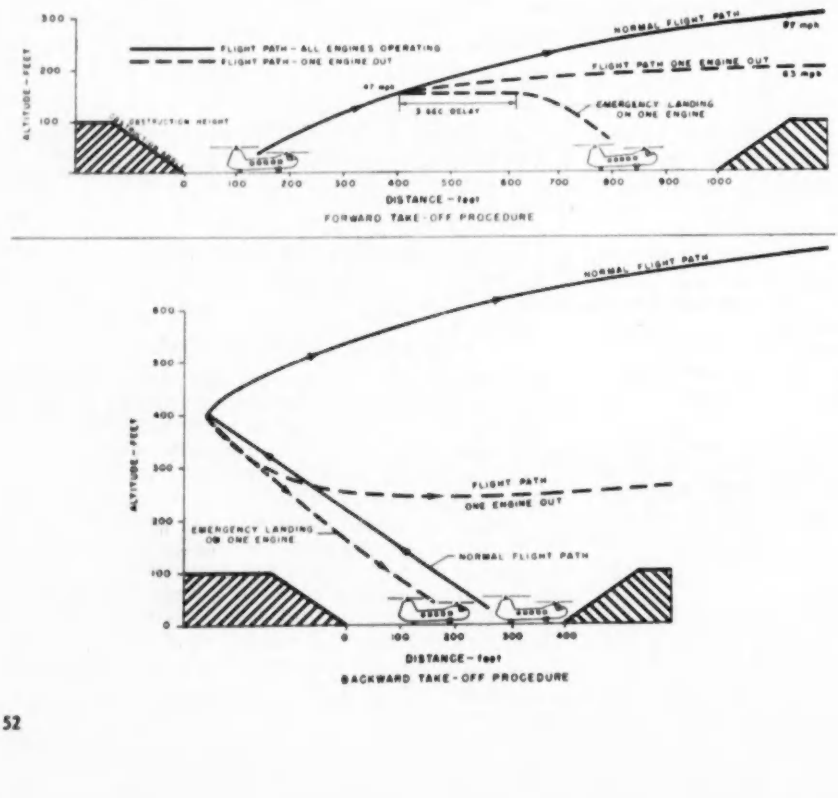


Fig. 2—Safe take-off procedures and effect on heliport dimensions—partial-power performance to meet CAR 6 requirements

be superimposed. Ground lighting aids must be provided for the changeover to visual reference. Cockpit layouts and view commensurate with en route and approach flight requirements differ considerably from those of the airplane. The search for visual reference, such as beacons, will have to be carried out through a greater vertical and azimuth angle.

5. Weather forecasting: In local operations, the helicopter operator will require knowledge of local weather as well as area conditions already available for the airplane. This information is vital to obtain the high regularity required of local service. New weather stations may be required—and new methods of assessing the weather, particularly the visibility at low altitudes.

6. Terminal minimums: from a full understanding of the foregoing problems will evolve the definition of practical terminal minimums. It is believed that certain terminal minimums may be developed to a 200-ft ceiling and a 500-ft horizontal visibility. Such developments will require much operational flying under all conditions to ensure their practicality. Completely blind landings may become possible for the helicopter sooner than the airplane because of its slower approach and descent speeds.

7. Ground equipment: Because of the number of heliports that will be required and the need to keep

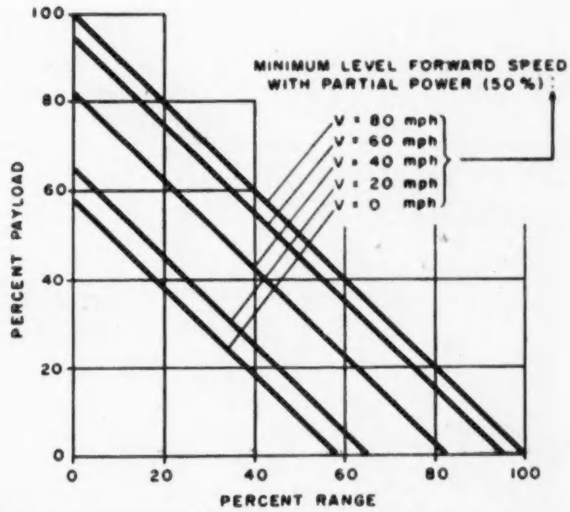


Fig. 3—Performance penalty of partial-power flight requirements—partial power = 50% installed power

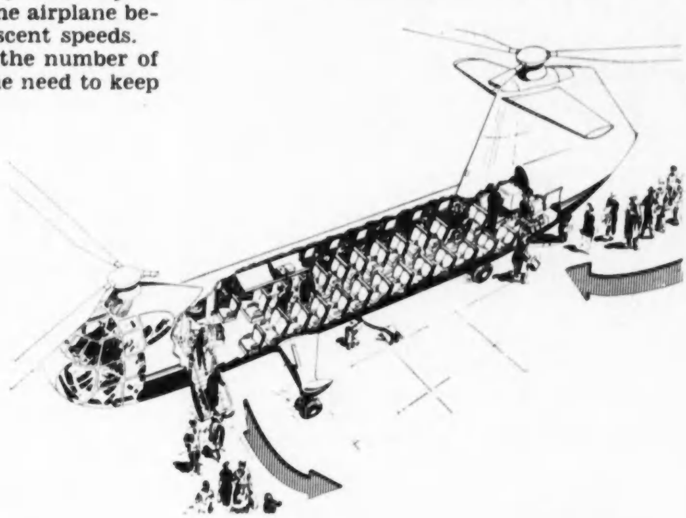


Fig. 4—Fast traffic and ground handling technique for large intercity Piasecki H-16 helicopter—one-way passenger flow—rear entry and front exit

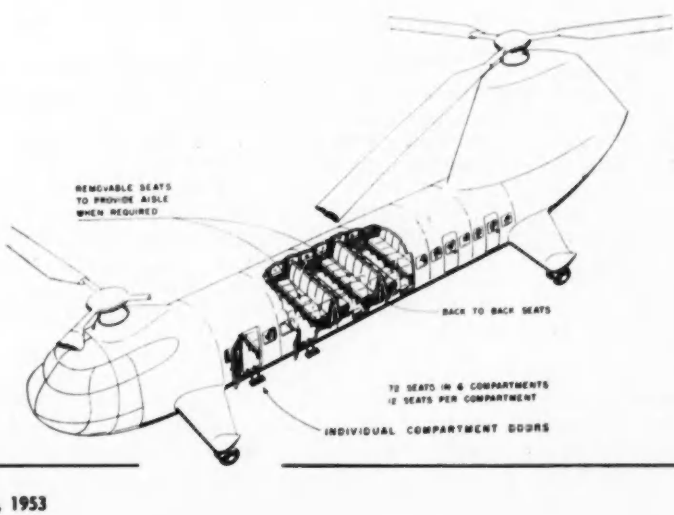


Fig. 5—High-density seating for local feeder services—patterned after European railroad car

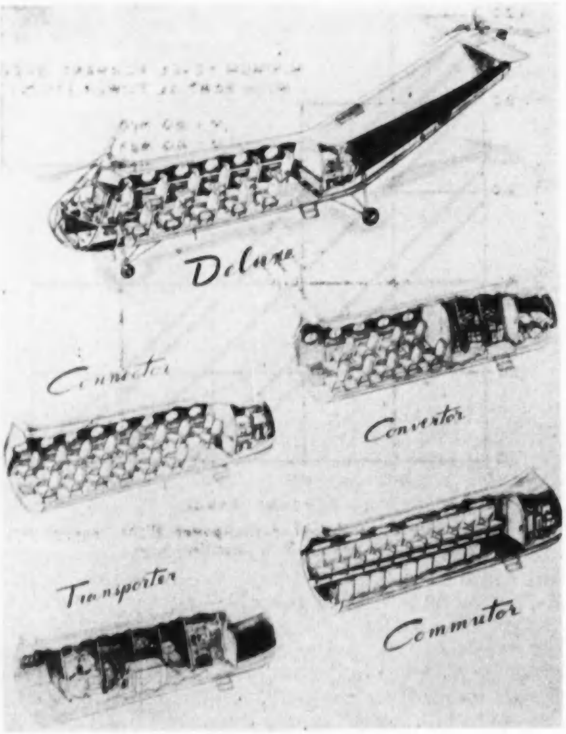


Fig. 6—PD-22 helicopter

indirect operating costs to the minimum, heliports should be unmanned in respect to operations and control. All aids should be automatic. Area control could provide the necessary traffic coordination.

8. Emergency landing equipment and procedures: The helicopter should carry sufficient airborne lighting and emergency flares to enable it to make an en route emergency landing. The ability to do this will provide a great advantage over the airplane.

Partial-Power Requirements

Partial-power safety and take-off-area requirements are interlinked for the helicopter in the same way as they are for the airplane, except that the speed range of the helicopter extends down to zero forward speed, at which point the power required to maintain height rises very steeply, as shown in Fig. 1. The full power of all engines amply covers all flight power requirements; but when the power is halved, as in the case of a twin-engined helicopter with one engine out, the helicopter can only maintain altitude through a much reduced speed range. If an engine fails before the minimum level flight speed has been reached on take-off, then the helicopter has to make a landing unless it can exceed its minimum level flight speed on its descent. If the total power of a twin-engined helicopter were double its hovering power, then this condition could not arise, but the penalty in weight would be high. Because of this, the proposed CAA requirement, which is considered to be rigorous, requires a climb performance of 1 in 20 at best forward climb speed with one engine out (between 250 and 400 fpm, depending on the speed). This sets a compromise between payload performance and safety but may possibly require that larger than originally anticipated landing areas be available to cover the critical take-off case. Fig. 1 shows how this requirement sets the minimum level flight speed, thus controlling the take-off procedure.

Fig. 2 shows how the take-off condition can be covered with helicopters meeting the CAA requirements. Were the worst case—a forward take-off—considered to be necessary, then this would entail a clear area 1000 ft long to be available to cover that stage of the take-off when a landing would be inevitable in case of engine failure. This would be a costly area to provide in the center of a city. The preferred technique is a backward take-off (Fig. 2), which allows a helicopter to return substantially down its take-off path in event of engine failure, thus permitting the use of an area 400 ft in length, as originally anticipated for large helicopters. This take-off technique has been widely used, for other reasons, in previous operations, but has to be thoroughly proved as an acceptable procedure against engine failure under all conditions. It will be appreciated that a delicate compromise has to be struck between partial-power flight requirements and the economic performance of the helicopter, on the one hand, and the economics of heliports on the other. The extent of payload penalty for a conventional helicopter, in connection with partial power safety, can be appreciated from Fig. 3, where the effect of providing for lower minimum safe flight speeds is plotted against the payload and range of a hypothetical but conventional mechanical-drive helicopter. This helicopter at a minimum safe level speed, with the partial power required for 80 mph, has a good vertical climb performance with full power. It will be seen that considerable penalties will arise if the minimum safe level speed has to be reduced below 40 mph in order to permit forward take-off to be carried out from small areas.

It is of the utmost importance that this problem be studied under practical operating conditions in order to establish a workable compromise at the earliest possible time. Until this question is resolved, helicopter and heliport development cannot be based on a firm foundation.

Arrangement of Passenger Accommodations

Helicopter short haul transportation poses fresh problems in passenger accommodation. Passengers traveling between 10 and 100 miles may accept lower standards than those traveling between 100 and 400 miles. Over very short haul it is important to fit the maximum number of seats into the cabin to utilize fully the available payload. And yet the operator may want day-to-day flexibility of his fleet over all block distances. What then are the minimum standards compatible with these requirements?

Standards already laid down call for nonreclining seats pitched at 36 in. and 20 in. wide between armrest centers. Although close to the minimum acceptable for 100-400-mile services, these are well above the standard considered acceptable for 10-

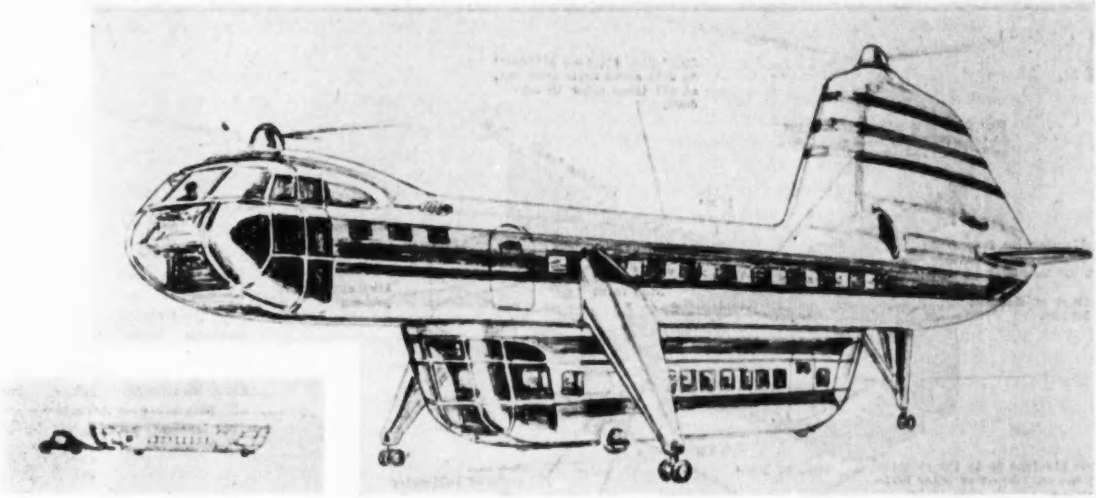


Fig. 7—Airline connection version—XH-16

100-mile services. Seating to this standard for 50 passengers is shown in Fig. 4. If armrests could be dispensed with and a removable seat used on 10–100-mile services, then the arrangement shown for the Piasecki H-16 in Fig. 5 would provide 72 seats in the same size of cabin, although some weight penalty might be incurred, due to the greater number of doors. This European rail coach concept could well speed up passenger movement. Fig. 6 shows the effect of various seating standards in the smaller Piasecki PD-22 helicopter.

An alternative method of providing flexibility of seating capacity is the capsule concept shown in Fig. 7. This type of arrangement, although entailing some weight penalty, will provide extra seating or freight capacity as required. In the latter instance, a freight capsule can speed up handling at turn rounds thus increasing the potential helicopter utilization, as shown in the illustration at the top of page 51.

It is assumed that toilet facilities will be required and possibly provision be made for serving light refreshments. Fig. 4 shows an arrangement of these facilities and also the portion allotted to baggage storage to enable passengers to carry their own baggage.

Since cabin arrangement and seating are important factors in design, it is clearly vital that these points be resolved at the earliest possible time.

Traffic and Ground Handling Techniques

Because the helicopter is a flexible short haul vehicle, it is vital that the time-on-ground stops be as short as possible. Not only must overall block speeds be maintained but also utilization must be high, for the reason expounded previously. Thus high ratios of flight time to ground transit time must be obtained.

Therefore, the helicopter passenger will have to be self sufficient to a degree approaching that of the railroad passenger. It is essential that helicopter service permit some relaxation of the tedious and costly system of reservations currently used with airplanes. This may be achieved by a partial reservation system on a surcharge basis and an on-the-spot-prior-to-flight mechanical reservation system at heliports. The fact that the point of departure is in the city center will assist in such relaxation of reservation systems acceptable to the public since switching to other ground transports can easily be done. In some cases frequency of service will bring about a reduced need for a positive reservation closely approaching city bus or even

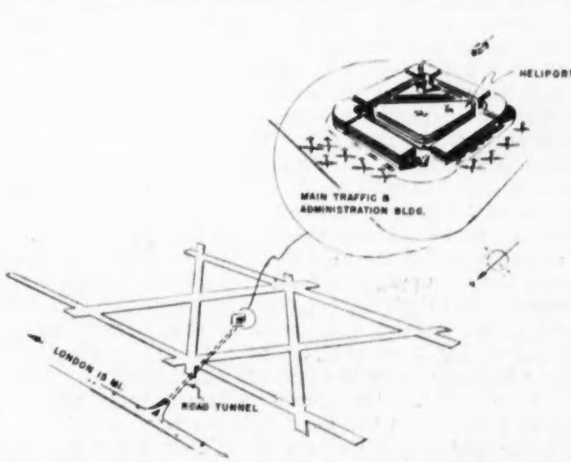


Fig. 8—Heliport proposal for London airport—proposed heliport consists of triangular roof of central car park building. Roof has 550-ft sides and has five stories of car parking space below. Passengers will descend by elevator to ground level, where they are within 440 yd of all airplane ramps. This proposal is currently up for approval

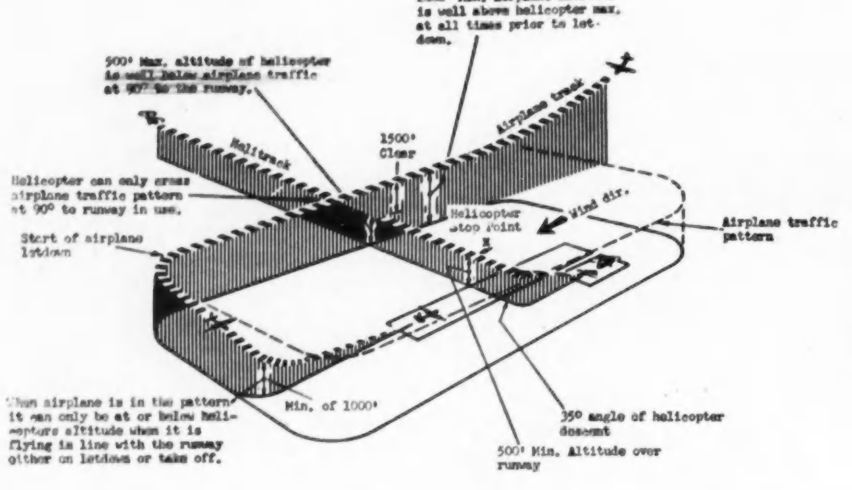


Fig. 9—Helicopter and airplane flight traffic patterns for major airports — worst landing case illustrated. Takeoff procedure is reverse of landing procedure

intercity bus and railroad service. Passengers must be encouraged to carry their own baggage. Traffic documentation must be kept to the minimum and current regulations for copies of passenger lists to be left at each stop should not apply to helicopters. A member of the crew should be responsible for all loading and dispatching duties so that the requirement for traffic staff at intermediate stops is minimized, if not entirely eliminated.

No ground handling equipment should be required —doors should have builtin steps—refueling points should be accessible immediately under the fuselage, builtin foot and handholds should enable quick checks to be taken of the rotor system and engines should be immediately accessible without the need of stands. Baggage holds should be accessible both from inside and outside the fuselage, while the external sills of the holds should be no higher than chest level. Two main doors should be provided to the cabin so that a one-way flow of disembarking and embarking passengers may be maintained at stops. Passengers should only be able to gain access to the ramp through an unmanned turnstile operated by tokens handed out with tickets. Fig. 4 shows some of the above principles applied. Passengers enter at the rear steps and immediately deposit their baggage in holds on either side of the steps or take their baggage to deep racks above their seats. On arrival, they leave by the forward door either taking their baggage with them or collecting their baggage from the outside hatches to the rear baggage holds. The crew member responsible for loading stands at the head of the rear steps checking the embarking passengers as they come up the steps. This technique would have to be carefully studied for a 50-seat helicopter of this type, but it is equally obvious that studies of these problems are required now to give the helicopter manufacturer and heliport architect the important requirements.

The essential link between airplane trunk and helicopter short haul services will take place at airports. As already stressed, it will be vital for their traffic patterns to be independent of each other such that neither class of operation imposes delaying factors upon the other.

The position of the helicopter landing area at major airports is of serious concern. The disembarking helicopter passengers must be within walking distances of the airline checkin counter if the helicopter is to offer the same connection convenience as the limousine and if the whole operation is to be smooth and simple. If the landing area is even one-half mile from the airline checkin counter, then the time delay incurred by the use of airport buses would nullify the advantages of the helicopter. This, therefore, implies that the helicopter will have to operate from the very heart of the airport and that the associated problems of control and flight procedure will have to be resolved. Fig. 8 shows one of the proposals for London Airport that would meet this requirement. Experience so far gained has shown that this flight problem is by no means as acute as it might appear to be, mainly because of the low operating altitude of the helicopter and its ability to maintain an accurate track. The ground facilities would have to be planned on the peak IFR movement rate. In Fig. 9 a proposed pattern is shown where the helicopters would cross the airplane runways at 90 deg at an altitude of not less than 500 ft. Clearance to cross the runway would be given by the airport control when the runway was actually free from airplanes taking off or landing, but this would not impose appreciable delay since the helicopter could hover while waiting permission. The illustration shows the worst case when the helicopter passes under the traffic pattern prior to crossing the runway. The airplane would be restricted to altitudes well above

the helicopter's operating altitudes in all positions other than on the runway approach and take-off zone.

Noise

Operating helicopters into cities will introduce new problems concerning noise. It is considered that engine noise may be the critical factor, particularly when shaft turbines are used. Some degree of silencing will be mandatory.

Acceptable levels of noise must be defined in conjunction with tests in specific locations. The situation may not be so acute if heliports are sited in city center business or industrial areas, unlike airports, which are generally in new suburban residential areas. However, when the helicopter operates into airports it will be subject to problems similar to those of the airplane.

Heliport Design

Major considerations in heliport design are position, traffic, operating techniques, size, construction, and not the least, cost, which must be considered in relation to all of these points.

Position is controlled by the need to possess good communication with all of the traffic generating area to be served. Heliports will be subject to movement restrictions under IFR. Estimates based on present knowledge have shown that a peak of 17 movements per hour might be achieved under IFR, which in turn could provide for a maximum of 850 passengers an hour when using 50-passenger helicopters. This capacity would, with the traffic requirements, determine the number of heliports for any one area. The positioning of adjacent heliports entails complete study of the IFR airspace requirements and operating techniques to avoid confliction of traffic patterns. Other aspects of operating techniques affecting heliport design are traffic handling and turn-round technique, discussed previously. Surrounding obstructions will have to be kept below a 35 deg angle generated from the periphery of the area or heliport. Locations will be limited accordingly.

It will be best to use ground sites initially until further knowledge is gained, but surrounding obstruction and desired position may leave no alternative but a roof top site. The latter will require consideration of concentrated loadings and other special construction features. Both types of sites will have to be seriously studied in respect to turbulence and special wind breaks or other devices to smooth airflow throughout the area.

The heliport size is largely controlled by partial-power emergency landing procedures. The preferred technique of backwards take-off will permit the use of a heliport of minimum size, as shown schematically in Fig. 10. Here a clear into-wind area 400 ft long and 160 ft wide allows sufficient emergency landing space for a typical 50-passenger helicopter. Parking area for seven such helicopters is provided, five of them with blades folded.

Standardization of Local Flight Ordinances

Since the helicopter will serve a greater number of communities than present airplanes, local ordinances concerning flight over builtup areas must be carefully studied with a view to establishing standardization and precedents for future operations. Otherwise, public sentiment is likely to be aroused in the same way as it has been in the vicinity of airports. Care must, therefore, be taken to ensure the best possible flight lanes over builtup areas from the aspects of nuisance factor and safety. Early action is required to secure the best compromise to avoid local legislation that could cripple helicopter services.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

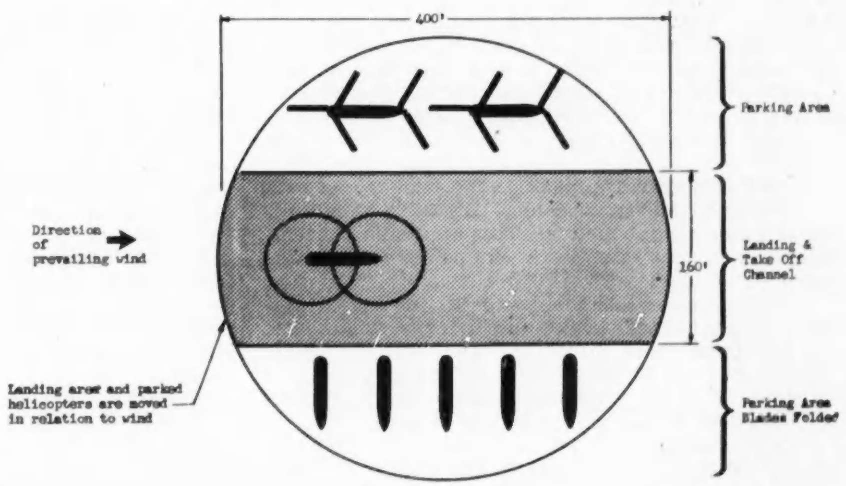
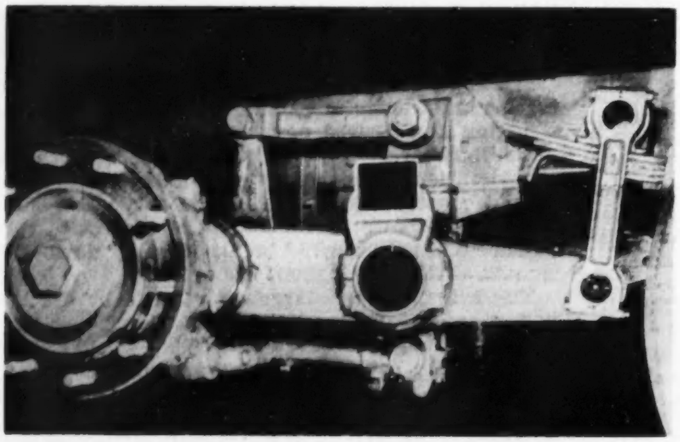
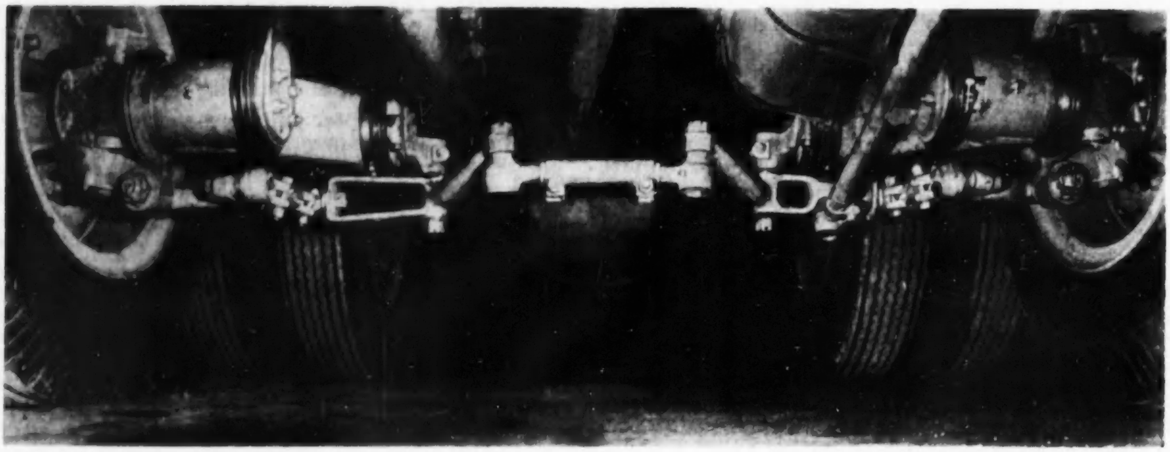


Fig. 10—Layout of heliport flight area requirements



Truck

Fig. 1—Views of the new White steering pusher axle



TRUCK designers and fleet operators have been hard at work trying to come up with ways of boosting vehicle payload, despite the squeeze from state weight restrictions. Light-weight alloys, particularly aluminum have been cutting vehicle weight. Tandem dual axles also help. But White's new pusher axle offers an even greater potential in payload increase by way of more effective weight distribution.

The best known approach to greater payload with limited axle weights and total allowable weights is by the use of light metals. This approach contemplates primarily the more extensive use of aluminum.

Great progress has been made in the use of aluminum for lighter weight and more payload. The Pacific Coast area seems to have been the most progressive as three California truck producing companies have developed lighter weight trucks and tractors by the extensive use of aluminum.

These companies by name of their equipment are White-Freightliner, Kenworth, and Peterbilt. They have reduced weights by 2500 lb or more, representing approximately 18 to 20%. This has come about through the use of aluminum in nonwearing parts.

The trailer companies have done an outstanding job on weight reduction through the use of aluminum and stainless steel. Trailer and body weights are now down to about their lowest achievable point within acceptable standards of life and wear.

Truck designers should avail themselves of aluminum wherever it is feasible and economical. The data furnished in Table 1 was prepared by the Aluminum Co. of America and shows the relative cost per pound for weight saving by the use of aluminum in various design components. It is interesting to note that it varies from over 70¢ per lb on some parts to less than 20¢ per lb on others. This comparison immediately shows the designers where substitutions can be made to maximum advantage costwise.

The point of application where substitution of light weight metal is economcial and sound must be determined by its contribution to lower costs or greater earning power to the truck user because of its lighter weight. This then becomes an evaluation of the greater payload made possible through

Pusher Axle Takes on More Payload

J. N. Bauman, Vice-President, White Motor Co.

Excerpts from paper "Weight Reduction of Power Driven Highway Vehicles," presented at SAE National Transportation Meeting, Pittsburgh, Oct. 24, 1952.

weight reduction in terms of additional earnings to the truck user. It must be judged economical on the basis of the additional load made possible and its value as compared to the additional investment in the equipment required, and then measured in terms of miles of additional payload necessary to return the additional investment.

A determination of this fact, evaluated in terms of the equipment's normal life, will then indicate the maximum return that can be expected by the use of lightweight material and will furnish a test of its economic value.

This evaluation is based on carrying the full amount of the additional payload on every trip which in some instances will not be possible. Some factor should be employed to compensate for the inability to carry a full load on every trip in reaching final conclusions.

This method of evaluating lighter metal substitution on a basis of ultimate economy is illustrated by the following example:

- Estimated weight saved by aluminum substitution on tractor .... 700 lb
- Average additional cost per pound of aluminum per pound of weight saved 60¢
- Manufacturing cost of aluminum substitution 60¢ × 700 .... $420.00
- Translated into selling price $600.00
- Additional revenue from 700 lb additional payload @ average of 80¢ cwt .... $ 5.60 (350 mile trip)
- Additional revenue per mile .... $ .016

The mileage that must be operated with additional payload just to get back additional investment is approximately 40,000 miles. It should be remembered that the number of miles that must be operated to get back the additional investment will be in proportion to the rate in the class of freight hauled. The higher the rate the lower the number

Table 1—Cost of Saving Weight on Aluminum Alloy Chassis Parts

Item	Cost of Weight Saving/lb Saved
Forged Spoke Wheels (Dual Trailer)	20¢
" " " (Dual Truck)	35¢
" " " (Single Front)	40¢
Forged Disc Wheels	65¢
Sand Cast Spoke Wheels (Dual Trailer)	25¢
" " " " (Dual Truck)	40¢
" " " " (Single Front)	60¢
PM Cast Spoke Wheels—Use Forged Spoke Wheel Figures	
Spring Hangers—220-T4	50¢
" " 356-T6	40¢
Frame Cross Members—220-T4	50¢
356-T6	40¢
Rear Axle Housings	
Timken style with closed bowl	76¢
Eaton style with open banjo	32.5¢
Hubs	
Forged trailer dual	20¢
Sand cast trailer dual	40¢
PM cast trailer dual	20¢
Forged truck dual	30¢
Sand cast truck dual	65¢
PM cast dual	30¢
Forged truck single	33¢
Sand cast truck single	70¢
PM cast single	33¢
Brake Shoes (Compare with malleable)	
Rear Sand	25¢
Rear PM	10¢
Front Sand	35¢
Front PM	15¢

of miles required—the lower the rate the higher the miles required.

Real contributions can be made towards greater earning power of motor equipment on the highway through the use of light weight materials. The example presented is based on an average increase in cost for aluminum per pound saved of 60¢. This cost increases to as high as $1.00 per pound saved on certain substitutions. It seems obvious that consistent with satisfactory life of the parts and their dependability in service where aluminum substitution is made that the use of light weight metals is economically sound.

There's Another Way

There is, however, an additional approach to the urgent problem of designing motor truck equipment so that it can carry more payload. And this approach considers the design of the chassis itself in terms of load distribution that will permit maximum weight on the king pin of a tractor within legal axle and total GVW limitations. It is a fundamental factor and can actually gain more in payload per dollar of investment than the use of light metal substitution.

In pursuing this approach of designing to realize more load on the king pin of the tractor, three factors are important in determining the king pin load that can be applied:

1. Front axle capacity,
2. Rear axle load, and
3. Tare weight of chassis.

In considering front axle capacity, there are several limitations. The first is load capacity. In a conventional truck (hood out front of cab) the practical limit of front axle loading is approximately 8000 lb. Front axles of larger capacity are available, but to transfer sufficient weight forward requires excessively long wheelbases which greatly reduce maneuverability.

In a cab forward design, where there is no hood in front of cab and the engine is under the cab, practical front axle loading up to 10,000 lb is available. In the cab forward type, this transfer of weight can be obtained readily since the tare weight distribution is much heavier on the front axle and lighter on the rear axle of the tractor than on conventional equipment. The distribution should be as follows:

	Front Axle	Rear Axle
Cab Forward Tractor	6500 lb	3500 lb
Conventional	4500 lb	5500 lb

(Weights include cab and all normal equipment, including fifth wheel.)

It will be seen from this illustration that the cab forward type of tractor, provided it gives the type of tare weight distribution shown, will make possible more king pin load than the conventional tractor. In fact, it often amounts to approximately 3000 lb within legal axle limitations.

The rear axle of the tractor is always the critical axle in terms of legal weight limitations.

All states have restrictions on this axle that are enforced very rigidly. They are generally limited to 18,000 lb. Although in some states 22,000 lb is permitted.

It can be seen in the comparison made between a cab forward and a conventional that the cab forward permits a 2000-lb greater load than the conventional on the driver axle because its tare weight is that much lighter.

A dual axle can be used on the rear of the tractor to alleviate the critical load problem. In most states a dual axle load of 32,000 lb is legal. In some states this allowable load is 36,000 lb. However, the tandem has the limitation of heavier tare weight. And assuming a standard 36-in. king pin trailer is used, the tandem often necessitates equip-

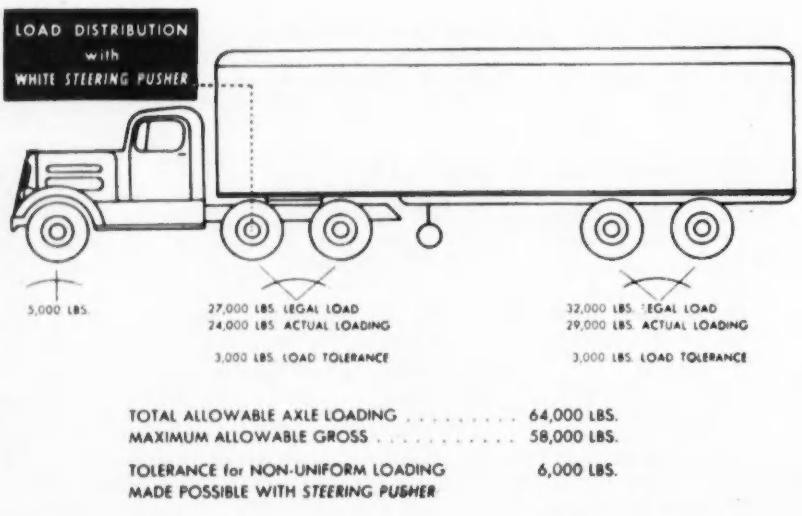


Fig. 2—How White pusher axle permits an additional payload of some 6000 lb

ment with landing gear mounted at least 11 in. back of front of trailer.

This is necessary because the fifth wheel on the tractor must be mounted approximately 10 to 15 in. ahead of the center line of the two axles. That's to transfer sufficient weight to the front axle to make the tractor steer and handle satisfactorily.

The Hitch with Tandem Duals

So the tandem dual axle tractor does increase the allowable GVW; but it is not the best solution for states having total allowable GVW of 58,000 to 60,000 lb. The tandem axle tractor with tandem axle trailer having fifth wheel located at up to 15 in. ahead of center line of the tandem would have a gross capacity of 72,000 lb. This far exceeds the 58,000 to 60,000-lb allowable. The higher investment and heavier weight do not indicate that this equipment solves the problem.

The fact that a tandem axle cannot give interchangeability with all trailers, even with landing gear 96 in. or less from the front of the trailer, represents a very serious disadvantage for this type of equipment.

To show why the reduction of tare weight should not be the only objective of the truck designer, a discussion of a different type of axle and weight distribution will be presented. This will show that the real objective of the truck designer should be to increase the load on the king pin. This must include two approaches:

1. The best possible chassis design to obtain the most favorable weight distribution within existing laws.
2. The judicious use of light weight metals in all elements of chassis design where they will be practical and economical.

Pusher Axle—A New Angle

The possibility of greater king pin loading through unique chassis design is shown by a study of a new development by White. In this design, shown in Fig. 1, an axle with an individual wheel mounted directly to the frame is placed ahead of the driving axle, and these wheels steer in coordination with the front axle. It is light in weight and equipped with only one tire on each wheel. This tire is the same size as used on the other wheels of the tractor.

The weight of this axle is 1350 lb including two 10.00-20 tires. This combination of the tractor's drive axle and the additional axle is permitted to carry 27,000 lb on state highways. So with this tractor combined with a dual tire trailer, the allowable axle loading is 64,000 lb.

This is approximately 4000 to 6000 lb in excess of the maximum allowable GVW in many states. But its light weight and lower investment requirements make it a practical unit where the two axle tractor cannot reach maximum allowable GVW. This is shown by the example in Table 2.

It will be seen that the conventional tractor cannot attain the legal allowable in many states. The cab forward type of tractor is able to approximately reach the maximum allowable GVW.

The problem, however, in attaining greater payload now introduces a new factor—the non-uniformity of the load carried. In a large majority of over-the-highway loads, the commodities or materials differ in weight and the loads are not uniform.

Table 2—Examples of Maximum Allowable GVW

	Front Axle Tractor Design Limitation	Rear Axle Tractor Legal Limit	Rear Axle Trailer Legal Limit
Conventional Tractor	7500 lb	18,000 lb	32,000 lb
	Total Axle Loadings		57,500 lb
Cab Forward Type	10,000 lb	18,000 lb	32,000 lb
	Total Axle Loadings		60,000 lb

It can be seen that in the case of the two axle tractors, both conventional and cab forward types, the rear axle of the tractor and the rear axle of the trailer must be loaded right to the maximum allowable by law. In the large majority of truck operations, this is not practical because the loads do not run uniform and it would be too costly to spot each commodity in loading the trailer to give the distribution required.

This problem can only be solved by loading the front end light to avoid overloading the driving axle. As a result, the transport unit goes on its trip with 3000 to 4000 lb less payload than it was permitted to haul legally. About the only exception to this is the transporter of liquids which, of course, are uniform in weight.

The tractor with the light-weight steering pusher axle (see Fig. 2), having an excess of approximately 6000-lb axle loading over allowable total gross load, can use this excess for tolerance on each axle. In other words, the tractor rear axles and the trailer rear axles are so located that to attain maximum allowable GVW, they need only be loaded to 24,000 lb tractor rear axle and 29,000 lb trailer axle. This leaves a tolerance of 3000 lb for each axle under the legal limit. With this arrangement, nonuniform loads can be loaded as they come without concern of overloading axles. It results in the ability to carry more total payload per trip.

There was another problem that developed in making such a design practical. There is in service a very large number of trailers. Many of these have landing gear located 96 in. from the front of the trailer. Since a tandem axle tractor must transfer about 22% of its load on the front axle to make it a safe vehicle on the highway, the fifth wheel must be located about 10 to 15 in. ahead of the center line of the two axles.

With this dimension, a tandem axle trailer can only operate with a 36-in. king pin trailer having landing gear 110 to 114 in. back from the front of the trailer, because of clearance between tractor rear axle tires and landing gear. This means that such a vehicle cannot interchange with existing trailer equipment, which limits its practical use very severely.

To make a dual axle tractor so that it will interchange with existing trailers, the fifth wheel must be located about 8 in. behind the center line of the

two rear axles. With this arrangement, the tractor can interchange with trailers having landing gear only 96 in. from front of trailer.

It will be seen that with this location of fifth wheel, there is no load transferred to the front axle. To make a tractor of this type satisfactory from the point of view of road safety and handling, the pusher axle of the tractor driving axle steers in coordination with the front axle of the tractor. The ratio is 1 to 3. In other words, when the front axle is turned 22 deg, the pusher axle turns 7 deg. With this arrangement, the combined weight of the front axle and the pusher axle is about 14,000 lb so that this amount of weight is steered. It gives excellent control and greater safety under all types of highway conditions.

The steering pusher axle itself consists of two wheels with knuckles at the ends, controlled by draglinks and tie rods, and coordinated with the steering of the front axle. It is of simple mechanical construction, each wheel being independently mounted to the frame. The load transfer point is from the front of the rear spring. The pusher axle is so designed that it carries one-third of the load of the combination.

So the importance of chassis design in terms of weight distribution to enable truck users to carry more payload must be apparent. In fact, the design factor offers greater opportunity for payload increase than the weight saving by substitution of light metal. It is by a combination of the two that the maximum result will be obtained.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.)

Overengineering . . .

. . . is a real danger these days. Engineers must not be hypnotized by the beauty of their own complications. Should always ask: "Is a new complication worth while?"

Excerpts from paper by **Robert E. Wilson** Standard Oil Co. (Indiana)

MACHINES seem to have ahead of them a future of increasing mechanical complications. The objective of the complications will be to obtain either operating ease or increased performance.

If I may sound a warning, I should like to warn against the tendency of a few engineers to be hypnotized by the beauty of their own complications, and to lose sight of the main objective. There is such a thing as overengineering. We should always ask whether a new complication is worth while, particularly at a time when engineering complications cost rapidly increasing amounts of money. The painfully slow-acting push-button mechanism for raising and lowering the toilet bowls in the bedrooms of the Century are a case in point!

It is also possible to overengineer more serious items. Someone recently remarked that in Korea we are using Cadillacs to fight hot rods. We might gain more objectives and lose fewer lives if we used less elaborate planes, but had more of them. This is a question on which I do not pretend to be an expert, but it is one engineers must think about.

The United States is an outstanding nation of gadgeteers. As users, we are fascinated with gadgets; and to some engineers, the chance to devise one more gadget, either to replace a manual operation or to perform a completely new operation, is almost too intriguing to resist.

There are many evidences that too much emphasis is being placed on gadgetry and automaticity. The cockpit of an airliner is a frightening thing to behold. Automatic window-raising devices for automobiles are convenient, provided you have plenty of time to keep the children from playing with them and running down the battery—but how helpless you are when they get out of order!

Even the modern home is dangerously close to the place where the merits of automatic gadgets may be offset by increasing frequency of failure to operate. You've probably seen that *New Yorker* cartoon where the maid in a modern all-electric kitchen has her framed diploma as an electrical engineer.

True engineering does not necessarily mean increased complexity. The highest achievement would consist in eliminating the difficulties or situations requiring gadgets, rather than in inventing new gadgets to handle the trouble. The most satisfactory solution to the problem of the leaky fountain pen is not the introduction of rubber gloves.

True needs must be met. But one of the toughest exercises in engineering judgment is that of determining whether an apparent problem should be wrestled with through the avenue of additional equipment and complexity, or whether it can be eliminated by simplification. This reminds me of my favorite definition of a good engineer—one who can draw sound conclusions from insufficient data!

Without question most of the automatic equipment devised by engineers is highly worth while—for example, in places where it eliminates possibilities of human error. (Paper, "Synergism Between Engineering and Petroleum," was presented at the Mineral Industries Symposium of the Centennial of Engineering, Chicago, Ill., Sept. 8, 1952.)

Extendable pod added to B-50 provides a straight air inlet outside fuselage boundary layer.

J-57 Turbojet Flight Tested in B-50

H. B. Archer, Pratt & Whitney Aircraft

Excerpts from paper "Operational Experiences with Flying Test Bed Airplanes" presented at SAE National Aeronautic Meeting, Oct. 4, 1952, Los Angeles.

PRATT & Whitney Aircraft has been flight testing its J-57 turbojet suspended in a pod from the forward bomb bay of a Boeing B-50A.

The retractable, streamlined pod encloses the engine completely except for a short portion of the tailpipe. A diffusing-type engine-air scoop and two separate flush-type oil-cooler air scoops are provided. The pod is supported by a streamlined pylon attached to a trapeze in the bomb bay by means of four bolts which permit easy removal of the pod for engine replacement. Cut-outs in the bomb bay doors mate with the streamlined pylon so that in flight with the pod extended and the doors closed there are no unstreamlined surfaces exposed. It is necessary for the forward bomb doors to remain fully open when the pod is retracted.

The geometry of the pod support mechanism was arranged so that, with the pod extended, the test engine centerline is parallel to the airplane centerline, but when retracted it assumes a nose-up angle. In the fully retracted position, the air scoop mates with a fixed plug in the bomb bay to shut off all air flow and prevent picking up foreign material during take-off and landing. Retraction and extension is accomplished by two B-50 main landing gear actuating struts. A manual emergency retracting system actuated by a hand crank provides means of emergency extension in case of electrical system or actuating motor failure.

The two external droppable fuel tanks, of 700-gal capacity each, were isolated from the rest of the airplane fuel system and piped directly to the test engine. Due to restrictions on landing with fuel in these tanks and the undesirability of jettisoning them because of the replacement problem, overboard dumps were added.

Internally, the airplane was cleared of a large part of the armament. Provisions were made to carry all crew members in the forward pressurized compartment. An over-ride throttle, a manual fuel

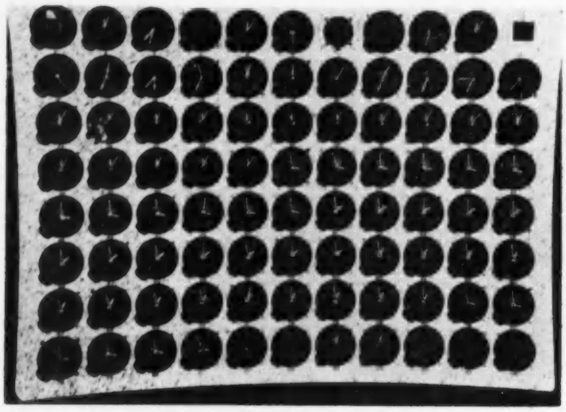


Fig. 1—Photo panel used in the B-50 flying test bed for automatic recording of test engine data

shut-off, and the pod retraction and extension controls were provided on the pilots' center aisle stand. Fire warning lights and extinguisher control switches were duplicated at the operator's station and in the pilots' compartment. A spherically-shaped photo panel with provisions for mounting 88 standard-size instruments was installed in the rear pressurized compartment (Fig. 1).

With five to six crew members, all in the forward compartment, it was necessary to provide emergency in-flight escape facilities in addition to the normal nose-wheel well route and, more important, to insure falling clear of the extended pod. This was accomplished by installation of a telescoping tunnel in the bottom turret well. This tunnel, in the stowed position, is completely contained in the cabin floor with covers on the top and bottom which are tied together by a quick-release mechanism. The pull of one handle drops the external cover which permits the tunnel to extend by gravity.

This flight test program accumulated 112 hours of J-57 engine operating time in 240 hours of airplane flight time. Early flight testing of the J-57 was planned as an integral and essential part of its development program. The flight program was started in March, 1951, 13½ months before eight of these engines were to take the YB-52 on its maiden flight.

In-flight investigations, the results of which have served as a basis for improvements, have been concerned with:

1. Performance evaluation
2. Engine stability
3. Fuel control development
4. Air-starting
5. Oil system development

The B-50 is Pratt & Whitney's third flying test bed. The earlier two were a P2B, used in testing the J-42 and the J-48, and a B-17, used in testing the T-34. The company's fourth flying test bed will be a modified North American B-45C for testing the J-57 at higher speeds and altitudes.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Discussion . . .

Comment by R. R. Templeton,
North American Aviation, Inc.

From the airframe manufacturer's viewpoint, it appears that the use of flying test beds should not only be continued but should be amplified.

In many cases the flying test bed programs are preoccupied with the development of the basic power package to the practical exclusion of the numerous and complex accessories, the satisfactory function of which is essential to the operational suitability of an airplane whether it be military or commercial.

A flying test bed program cannot be considered successfully completed until it produces an engine fully equipped with all units necessary to complete the airframe installation. It seems only reasonable to expect that this combination should function acceptably and safely throughout the operating regime of the airframe or airframes for which it is intended.

Another past weakness of flying test bed programs is that in many cases the test program was not designed to use the engine and its components as they would be used in actual practice. As an example, air turbine driven pumps are frequently used on turbojet engines to pump water or fuel for thrust augmentation. The majority of these pumps known to NAA have little if any operating life when the fluid supply is interrupted without first turning off the air to the turbine.

Yet in several cases, pumps with a life (after fluid supply failure) measured in fractions of a second have been carried completely through the development test program and installed in fighter-type airplanes, where several seconds of inverted flight or negative acceleration is implicit in the airplane mission, without any recognition of the fact that the pump design was incompatible with the intended use. Failure to discover a discrepancy such as the above before installation of the component in the actual airplane clearly shows that the development test program did not include tests which would realistically evaluate the engine and component in terms of the intended airframe installation.

Since the design and test engineers responsible for detail configuration of the engine and components cannot logically be expected ever to be as familiar with the requirements of the airframe as their counterparts who have the responsibility for the airframe—and vice versa—it is suggested that considerably more coordination between the two groups during the development of the engine would be mutually advantageous.

Aluminum Alloy Family Gets New Quartet

J. A. Nock, Jr., Aluminum Company of America

Based on paper, "Today's Aluminum Aircraft Alloys" presented at SAE National Aeronautic Meeting, Los Angeles, Oct. 3, 1952. Complete paper will be printed in 1953 SAE Transactions.

NEW and better members are constantly being added to the family of aircraft aluminum alloys. Here are a few of the more recent:

- Materials more suitable for use at elevated temperatures.
- A new high-strength structural alloy.
- Thinner, higher strength aluminum coatings.
- Higher shear-strength rivets.

Strong Materials at High Temperatures

With the advent of jet engines, higher strength at elevated temperatures became a must for aluminum alloy engine parts and aircraft structural members.

Early in the search for suitable materials, artificially aged aluminum alloys were found to be superior to naturally aged ones. In addition to higher initial strength, they did not suffer the measurable decrease in strength and resistance to corrosion experienced by naturally aged materials when initially exposed to high temperatures. Artificially aged 14S, 24S, 18S, and 32S alloys which maintain a relatively high level of strength at elevated temperatures thus came into use.

But other new materials soon entered the picture. Table 1 compares the tensile properties at room and elevated temperatures of two of them—XF18S and XA19S—with those of 18S, B18S, and 14S alloys. (In general, parts of XF18S are recommended for use at temperatures up to 475 F, while XA19S is suggested for temperatures at the 600 F level.) Strength of these new alloys is somewhat higher than that of the standard alloys at the temperatures shown. As for other properties, alloy XF18S possesses excellent creep resistance at 400 F. Alloy XA19S gets the nod at 600 F however. Fatigue properties of XF18S-T61 are superior to those of the other alloys at 400 F, but B18S-T61 appears to head the field at 600 F.

The search for even better high-temperature materials continues however . . . and several experimental alloys show great promise. One appears to have desirable characteristics for use in the low temperature range up to about 500 F. Another develops higher tensile properties than all currently available alloys at temperatures around 600 F. Considerable work remains to be done, however, before

Table 1—Comparison of Tensile Properties of Aluminum Alloys at Room and Elevated Temperatures

Tensile Properties at Room Temperature

	Tensile Strength, psi	Yield Strength, psi	Elongation in 2 in., %
XF18S-T61	63,000	52,000	11
XA19S-T6	61,000	43,000	13
B18S-T61	60,000	41,000	15
18S-T61	61,000	46,000	12
14S-T6	70,000	60,000	13

Tensile Properties at 400 F after 1000 Hr

	Tensile Strength, psi	Yield Strength, psi	Elongation in 2 in., %
XF18S-T61	34,000	31,000	24
XA19S-T6	39,000	29,000	18
B18S-T61	26,000	20,000	25
18S-T61	25,000	19,000	18
14S-T6	22,000	17,000	31

Tensile Properties at 600 F after 1000 Hr

	Tensile Strength, psi	Yield Strength, psi	Elongation in 2 in., %
XF18S-T61	10,000	6000	70
XA19S-T6	14,000	11,000	28
B18S-T61	6000	3500	75
18S-T61	6000	4000	50
14S-T6	7000	5500	64

these alloys may be considered satisfactory for commercial exploitation.

In the meantime, a new development of unusual interest has been under investigation by Alcoa for several years—aluminum powder metallurgy. Discovered by a Swiss inventor, this is a process for producing articles of pure aluminum powder which have exceptional properties at room and elevated temperatures. Particle size of the powder and the oxide film covering these particles are cited as reasons for the superior properties obtained.

Table 2 shows a comparison of room and elevated temperature properties of aluminum powder metallurgy products (APMP) with those of several alloys normally used for high-temperature applications. (These products were produced at the Aluminum Research Laboratory, but not according to Swiss patents.)

It can be seen that strength of the alloys is much higher at room temperature. Also some degree of superiority still exists for the alloys after short heating periods at temperatures as high as 500 F. However, after long periods at 400 F, 500 F, and higher temperatures, the new material has tensile properties far superior to any alloy now commercially available. Indeed, an outstanding characteristic of this material is its ability to keep its strength as the period of exposure at elevated temperatures is increased.

As for other characteristics, creep properties of most of the alloys are somewhat better than those of the aluminum powder product at 400 F. But the creep properties of the new material are superior at 600 F. Fatigue properties of the alloys at 400 F and 600 F are slightly superior to powdered aluminum. However, there is some indication that the latter may have better fatigue properties at higher temperatures.

Right now facilities are not available to quantity produce aluminum powder products. But efforts are being devoted to determining the high-temperature potentialities of this new material.

Higher Strength Structural Alloy

Just as materials suitable for use at higher temperatures are in demand, so are higher strength structural alloys. Latest to enter the field is XA78S. Introduced experimentally about a year ago, this new alloy may be most aptly described as a higher strength 75S-type alloy. As shown in Table 3, it develops about 10% higher strength than 75S. This increase in strength, however, is accompanied by some decrease in formability and resistance to stress-corrosion cracking.

In the development of XA78S, many other compositions, including alloys that would produce appreciably higher strength, were studied. But XA78S was selected as the most desirable compromise on the basis of fabricating characteristics, strength, resistance to corrosion, and resistance to stress-corrosion cracking.

Right now various aircraft companies are evaluating sheet, alclad sheet, and extrusions of the new alloy. So far the reaction of the aircraft industry has been very conservative. This is logical since use of 75S to the maximum degree has not been accomplished, and the advantage in strength secured by using XA78S is relatively small. To date, the evaluation confirms results obtained with experimental material. Some products are slightly less corrosion resistant than similar products of 75S, but, on the whole, the results are encouraging.

Thinner and Stronger Cladding

In the area of aluminum coatings, marked progress has been made recently in several directions. Not only have methods been found for applying thinner coats to sheet and plate, but stronger coatings are in the offing.

As a rule, cladding thickness is fixed at a certain percentage of the total thickness of the sheet or plate that is to be given this electrolytic protection. With the lighter gages, this presents no problem. With the heavier ones, however, coatings often become thicker than necessary, thus adding unnecessary weight.

This situation has been recognized in the case of Alclad 14S and Alclad 24S sheet products. For example, in the case of Alclad 24S, cladding is a nominal 5% on each surface of 0.063 in. or less thick sheet, but only 2.5% on each surface of sheet 0.064 in. or more in thickness.

On Alclad 75S sheet, cladding was formerly fixed at 4% on each surface for all thicknesses. But recent developments in the methods of applying thin coatings now make it possible to offer 0.188 to 0.50 in. Alclad 75S sheet and plate with a coating thickness of about 1.5% on each surface. This thinner coating provides ample electrolytic protection to 75S-T6, removes the weight penalty of excess cladding, and results in increased strength.

Coatings themselves are generally very soft, since few contain alloying elements in sufficient amount to respond to heat-treatment. This problem has been under investigation for many years, and much interesting information has been accumulated.

It has long been common knowledge that many non-heat-treatable aluminum-magnesium alloys have endurance properties in the annealed temper only slightly lower than those of many heat-treatable alloys in the T3 or T6 tempers. But many tests have definitely established that alclad coatings of such alloys (52S, 56S, and others) do not materially improve the endurance limit of Alclad 75S-T6 sheet or other high-strength clad sheet. Several types of heat-treatable alloys with intermediate strength and high endurance limits likewise offer little or no improvement in the endurance limit of the ultimate product. And the problem is further complicated by the desirability of maintaining an adequate potential difference between the high-strength core and the cladding.

Recent work in this field, however, has produced an alloy coating that will develop an endurance limit in the ultimate product which approaches that of the 75S-T6 sheet. What's more, the new coating will resist scratching and abrasion almost as well as 75S-T6. On the debit side of the ledger, the proposed cladding will discolor much in the same manner as heat-treated aluminum alloy sheet, and resistance to corrosion is not expected to be equal to that of 72S now used. (Both of these factors may be objectionable from the appearance

Table 2—Properties of Aluminum Alloys and Aluminum Powder Metallurgy Products at Elevated Temperatures

Temperature of Test, F	Time, hr.	APMP* Tensile Strength, psi	APMP* Yield Strength, psi	APMP* Elongation in 2 in., %	18S-T61 Tensile Strength, psi	18S-T61 Yield Strength, psi	18S-T61 Elongation in 2 in., %	XF18S-T6 Tensile Strength, psi	XF18S-T6 Yield Strength, psi	XF18S-T6 Elongation in 2 in., %	XA19S-T6 Tensile Strength, psi	XA19S-T6 Yield Strength, psi	XA19S-T6 Elongation in 2 in., %
Room	....	35,800	24,600	16	61,000	46,000	12	63,000	52,000	11	61,000	43,000	13
400	0.5	21,400	18,000	16	42,000	35,000	12	45,000	41,000	19	40,000	31,000	18
	100	....	....	..	37,000	31,000	15	36,000	32,000	24	39,000	29,000	18
	1000	....	....	..	25,000	19,000	18	34,000	31,000	24	38,000	27,000	21
	10,000	....	....	..	19,000	13,000	25	....	....	..	....	....	..
500	0.5	18,600	16,400	17	31,000	27,000	15	29,000	26,000	24	29,000	23,000	19
	100	....	....	..	18,000	14,000	25	21,000	17,000	35	28,000	21,000	19
	1000	....	....	..	14,000	9500	30	19,000	13,000	47	28,000	20,000	20
	10,000	....	....	..	10,000	6500	40	....	....	..	....	....	..
600	0.5	15,700	14,000	15	13,000	10,000	25	17,000	14,000	32	20,000	15,000	18
	100	16,900	15,000	13	9000	7000	40	11,000	8000	49	19,000	14,000	18
	1000	16,000	14,400	17	6000	4000	50	10,000	6000	70	14,000	11,000	28
	10,000	....	....	..	5500	3000	60	....	....	..	....	....	..
700	0.5	14,200	13,000	8	....	....	..	8500	6500	..	....	....	..
	100	....	....	..	....	....	..	5500	4500	..	....	....	..
800	0.5 to 1000	12,000	11,000	5	....	....	..	....	....	..	....	....	..
900	0.5 to 1000	10,800	10,500	4	....	....	..	....	....	..	....	....	..
1000	0.5 to 1000	7300	7200	2	....	....	..	....	....	..	....	....	..

* Aluminum Powder Metallurgy Product

standpoint.) Fabricating difficulties also remain to be overcome.

Nevertheless, this new material may be of interest if fatigue becomes a problem in the use of high-strength clad sheet. In the meantime, more detailed evaluation of the material must be completed before it can be considered commercially.

Greater Shear-Strength Rivets

Aircraft rivets with higher shear strength than commonly used 24S rivets are another newcomer. Made of 75S-T6, the shear strength of these new rivets is about 48,000 psi—15% better than the 42,000 psi of 24S-T31 ones.

Actually, rivets of 75S in aircraft sizes are capable of developing shearing strengths of about 54,000 psi when heat-treated at 860 to 920 F and aged for 24 hr at 250 F. But driving at room temperatures cannot be accomplished without severe shear cracking of the driven heads. Satisfactory room-temperature driving characteristics can be obtained, however, by giving them a two-step aging treatment consisting of 3 hr at 250 F and 3 hr at 325 F. In this case though, while resulting shear strength of 52,000 psi is still very good, the rivets do show some susceptibility to stress-corrosion cracking.

This problem has received much attention. Some investigations have concentrated on developing the utmost in shear strength and overcoming the troubles of driving at room temperature by driving rivets warm at temperatures around 300 F. This method shows promise of eliminating head cracking during driving, but susceptibility to stress-corrosion cracking still exists. Other attempts to develop 75S rivets with satisfactory resistance to stress-corrosion cracking have been successful—but at a sacrifice in shearing strength.

Table 3—Comparison of Specification Properties of Alcoa 75S and XA78S

Alloy	Thickness in.	Tensile Strength, psi	Yield Strength, psi	Elongation in 2 in., %
		Sheet		
75S	0.016-0.039	76,000	65,000	7
XA78S	0.016-0.040	83,000	72,000	7
75S	0.040-0.499	77,000	66,000	8
XA78S	0.041-0.499	84,000	73,000	8
		Alclad Sheet		
75S	0.016-0.039	70,000	60,000	7
XA78S	0.016-0.040	76,000	66,000	7
75S	0.040-0.499	72,000	62,000	8
XA78S	0.041-0.499	78,000	68,000	8
		Extrusions		
75S	To 0.249	78,000	70,000	7
XA78S	To 0.249	84,000	76,000	5
75S	0.250-2.999	80,000	72,000	7
XA78S	0.250-2.999	86,000	78,000	5

Using the latter approach, 75S-T6 rivets, aged by a step-treatment, were recently developed which have a shear strength of about 48,000 psi—an improvement of 15% over 24S-T31 rivets. What's more, the mere fact that the rivets have a T6 temper eliminates the need for solution heat-treating immediately before driving or refrigerating after quenching to preserve the driving characteristics.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Here's How Procurement Can

AIRCRAFT procurement must be improved. Just as the rider was lost for want of a nail to shoe his horse, so . . .

> For want of a rivet, the subassembly was lost.
>
> For want of a subassembly, the wing was lost.
>
> For want of a wing, the airplane delivery was lost.

It's up to procurement not to let this happen. This department must see to it that high quality "rivets" are always available at the right time and at the lowest possible cost. And this isn't easy.

Aircraft procurement is as complex as the function itself is far-reaching. Subcontracted parts and subassemblies number in the thousands. Engineering changes constantly take place. Issuing of 100,000 documents a day is not uncommon. Subcontractors often need help in securing tools, machinery, and materials so they can meet delivery dates. On top of all this, these two bywords haunt purchasing agents—keep quality up, costs down.

Just what, then, can be done to cut this mammoth operation down to size? How can overall efficiency of aircraft procurement systems be improved? Here's how procurement can shed four troublesome situations:

- **Simplify and Reduce Documents**
- **Harmonize Relations between Buyer and Supplier**
- **Expedite Only Critical Items**
- **Develop Duplicate Sources of Supply**

(1) Simplify and Reduce Documents

Simplifying and reducing the number of procurement documents would relieve one big procurement headache. Right now, at least eight major types of documents pass between aircraft manufacturers and suppliers . . . many in avalanche quantities. These groups include buying, design data, tooling, processing, inspection, follow-up, shipping and routing, and accounting documents.

Take, for example, the case of one aircraft manufacturer who has approximately 20,000 employees working on military contracts for one customer. (The largest proportion of this work is on one basic model aircraft, the balance being on special weapons.) Its material division contains 1400 people who issue and handle reams of paper at the rate of 100,000 pieces per day—on no less than 331 different forms! Needless to say, suppliers and prime contractors are often beset with difficulties in handling this deluge of paper.

Why, then, are so many documents issued? Most of the blame can be pinned on one all-powerful word—change. This is the element which, more than any other, dictates business practice in producing military weapons. With constant changes and short schedules, nothing can be left to chance. Everything must be recorded, then circulated to all affected departments.

This of necessity means that rivers of paper must flow both ways between aircraft manufacturers and suppliers. But aircraft manufacturers are going all out to simplify documents and eliminate duplication wherever possible. Efforts are being made, for example, to draw up uniform inspection procedures. Other work is being aimed at more standardized purchase order terms and conditions.

So far, such work has been slim, it's true. But a great deal more can and will be done as industry gets together to solve this mutual problem.

S simplify and reduce documents

H harmonize relations between buyer and supplier

E expedite only critical items

D develop duplicate sources of supply

4 of Its Shackles

G. L. Wade, Purchasing Agent, Douglas Aircraft Co., Inc.

Report on Panel on Procurement held at the SAE Aircraft Production Forum, Los Angeles, Oct. 1, 1952, under the auspices of the SAE Production Activity. Panel leader was D. J. Bosio, Douglas Aircraft Co., Inc., panel co-leader was R. Nagley.

(2) Harmonize Relations between Buyer and Supplier

Relations between aircraft manufacturers and subcontractors just cannot be too close and harmonious. It's extremely important that, prior to commencing work, both parties should have a clear understanding of not only the letter of the contract, but also its spirit and intent.

The article to be subcontracted and the schedule to be achieved should be clearly defined. Shop documents that are necessary to provide the subcontractor with the greatest amount of know-how should be provided. Bills of material covering both contractor-furnished items and customer-furnished equipment should be compiled and readily accessible. And that's not all. There are many other items of importance, all of which should be covered in a source book. This book gives a comprehensive outline of the job to be performed by the subcontractor.

Still another way to promote harmony and understanding is for the prime contractor to maintain a small, well-trained staff at the plant of a major subcontractor. Conversely, it's a good idea for the subcontractor to station a representative at the prime contractor's plant. In this way, both parties may clearly understand at all times the job to be done and the schedule to be maintained.

concluded on next page

(3) Expedite Only Critical Items

Without a doubt, the most important function of procurement is to get delivery of materials on time. And one way to promote this is to set up an efficient expediting system.

This doesn't mean that all items have to be expedited. Far from it. It's needless waste to expedite all items when only 10% cause the most trouble. A good expediting system puts emphasis on getting critical items delivered, and lets the routine ones take care of themselves.

Expediting may, for example, be carried into the field. In this case, a representative of the prime contractor works with the supplier, helping him secure tools, materials, machinery, and so forth.

Actually, however, the best way to insure delivery on time is setting up a schedule which allows the supplier enough time to fabricate his product. Many cases occur where sufficient time is not allowed, and the supplier, to secure the order, has to make impossible promises of delivery. For that matter, prime contractors are up against somewhat the same thing. They are constantly receiving contracts which do not allow adequate procurement time.

This latter condition necessitates that prime contractors spend tremendous sums expediting and installing equipment out of production sequence . . . and this boosts aircraft cost.

Several approaches would help to alleviate this problem. A concerted effort on the part of prime contractors and their subcontractors to get back on schedule would be a big step in the right direction. So would more consultation with procurement units before making company commitments on new contracts.

(4) Develop Duplicate Sources of Supply

No procurement department should find itself in the position of having a single source of supply if it can be avoided. There are at least three good reasons why duplicate sources of supply should be developed. Such an arrangement assures:

- Competitive quotations
- Adequate supply
- High quality products

Additional sources provide a buyer with a measuring stick for the true value of the item he is buying. When two or more companies are competing for the same order, prices just naturally tend to be lower.

Duplicate sources provide a second line of defense, too. They furnish protection against delivery delays due to strikes, shortage of materials, and many other factors that suppliers encounter in the normal course of business. What's more, duplicate sources permit quick expansion in deliveries when schedules are moved up.

Finally, the supplier who realizes that his product is to be directly compared to his competitor's constantly strives to improve quality. He also endeavors to be a little ahead of the next fellow in increasing efficiency of his product.

In short, then, prime contractors are constantly surveying new shops and facilities with a view toward getting good articles, on time, at reasonable prices.

Procurement has a big job to do. It's up to this department to get high quality products, on time, at reasonable prices. Four ways to make this job more efficient were outlined at a panel of the Los Angeles Aircraft Production Forum where these procurement experts presided: (left to right) J. W. Hinchliffe, Northrop; A. R. Campbell, Rohr Aircraft; W. Shulver, Jr., Lockheed; Panel Leader D. J. Bosio, Douglas; Panel Co-Leader R. Nagley, North American; and Secretary G. L. Wade, Douglas

Cold-Starting Ability Of Military Vehicles Is OK

Kenneth Boldt
Pure Oil Co.

C. S. Bruce
National Bureau of Standards

J. G. Moxey, Jr.
Sun Oil Co.

Based on paper, "Volatility Studies of Military Vehicles Covering CRC-Ordnance 1951-1952 Devil's Lake Work," presented at the SAE National Fuels & Lubricants Meeting, Tulsa, Nov. 7, 1952.

CRC-ORDNANCE tests undertaken at 0 F and -20 F indicate that for the current military tactical and combat vehicles:

- Warmup time is not too much of a problem.
- Starting problems are not very serious, although starting is not quite as satisfactory as warmup.
- The use of primers is definitely helpful.

These tests were carried out by the CRF-MFD Ordnance Fuel Performance Group of the CRC at the request of the Ordnance Corps. The tests were run at Camp Grafton, Devil's Lake, N. D., during the winter of 1951-1952.

The program was planned because, during World War II, it was found that some military vehicles were very difficult to start at atmospheric temperatures below 40 F. Engine warmup times of more than 40 min were often experienced.

The way the matter was solved at that time was to restrict the volatility limits for the tactical grade of gasoline. This was done because it was impossible to handle and distribute more than one volatility grade properly on a global supply scale.

Since World War II, the volatility requirements for the all-purpose grade (MIL-G-3056) have been relaxed somewhat to improve its availability.

Because this fuel is specified for use in areas where the atmospheric temperature range is 0-125 F, it was used in tests down to 0 F.

For the tests down to -20 to -25 F, an arctic grade of fuel (type C) was used, since satisfactory opera-

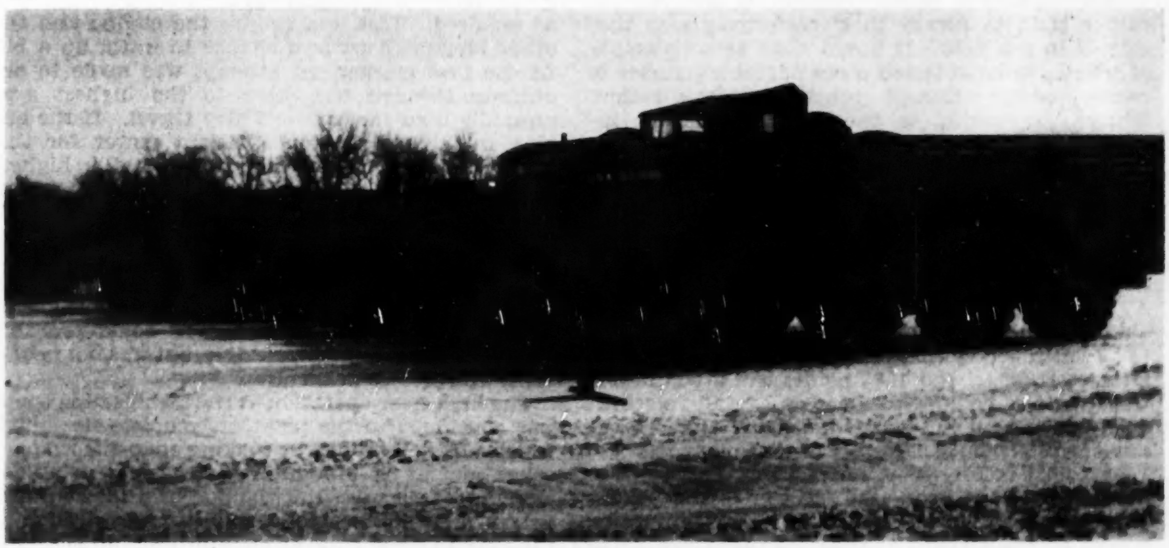


Fig. 1—Test vehicles parked in soaking area

IN April, 1951, the CRC received a request from the Research and Development Division, Office, Chief of Ordnance, for information concerning starting and warmup performance of military vehicles under cold-weather conditions.

The actual test work was performed under the leadership of the CRC Motor Fuels Division, which then issued a report of its findings. The accompanying story is based on this report.

The authors were connected with the project as follows:

Boldt is the leader of the CFR-MFD Ordnance Fuel Performance Group.

Bruce was the leader of the Devil's Lake Test Team.

Moxey is the leader of the Starting and Warm-up Program Panel.

tion is also expected down to these temperatures without benefit of winterization kits or special arctic equipment.

Test Vehicles, Fuels, and Oils

A total of 18 vehicles was made available by the Ordnance Corps for the test work. Thirteen of these were wheeled vehicles of eight different types; the remaining five were tracklaying vehicles of three different types.

New vehicles were used to assure optimum starting and warmup characteristics. The objective was to determine the basic behavior of the vehicles rather than to survey their performance as they existed in the field. It would have been desirable, of course, to have tested a considerable number of each model, although practical considerations limited the testing to two vehicles, in most instances, and, in some cases, to a single unit.

Fig. 1 shows some of the test vehicles parked in the soaking area.

The basic fuel used in the testing at 0 F was chosen to simulate the poorest fuel from a starting and warmup standpoint that would still be within the MIL-G-3056, Amendment 1, specification (type A). Ten, fifty, and ninety per cent points were all aimed at the upper limits, since starting is known to be controlled by that part of the distillation curve characterized by the 10% point; while warmup is thought of as being dependent on overall volatility, with the 50% point being of primary importance and the 90% point exerting a lesser influence.

A typical MIL-G-3056, Amendment 1, type C, or arctic grade, fuel was used for the testing in the -20 to -25 F temperature range. It also provided a means of evaluating the effect of fuel volatility in the 0 F range on vehicles that would not perform satisfactorily on the type A gasoline.

Since lubricants were not to be a part of the investigation, all of the vehicles were lubricated in accordance with recommended practice for the two temperature ranges involved. Down to 0 F a single batch of typical MIL-0-2104, OE-10 oil was used. At -20 F, an arctic grade MIL-0-10295 oil was used.

A mobile inspection laboratory was extremely helpful in conducting the test work. Frequent samples of fuel from both storage and vehicle tanks were inspected to insure against contamination and fuel weathering. Similarly, samples of oil were tested from each vehicle after each test as a means of checking on crankcase dilution.

Test Technique

The starting tests were quite conventional, involving the measurement of the time interval between the beginning of the starting attempt and the time the engine caught and continued to run. We decided that 15 sec should be the dividing line between satisfactory and unsatisfactory performance.

With one exception, all of the wheeled vehicles were equipped with both chokes and primers. The tracklaying vehicles were equipped only with primers, since they were all powered by aircooled engines, which did not lend themselves to conventional choking methods. As a means of evaluating the benefit to be derived from the primers, starting attempts were made first, without using the primer; and if no start was obtained in 30 sec, the primer was used the next time the vehicle was started at that temperature.

Immediately following the start, the engine was allowed to run at a fast idle for one minute. At the end of the minute, an attempt was made to get the vehicle under way. Starting at the soaking area, the test course was divided into 0.2-mile intervals; and the operation of the vehicle as it proceeded along the course was, briefly, as follows:

For the first 0.2 mile, the vehicle was kept in its starting gear and operated at a reasonable engine speed (2000 rpm), using the choke and/or primer as required. This was to give the engine and the other lubricated parts a chance to warm up a bit. At the first marker, an attempt was made to accelerate through the gears to the highest gear normally used for cross-country travel. If the engine would not develop sufficient power for this operation, running was continued in the highest gear attained to the next marker. Here, again, an attempt was made to up-shift. Operation in this manner continued until the vehicle was sufficiently warmed up to allow running in high gear at a relatively moderate speed (1000 to 2000 rpm, depending on the vehicle) without the use of either choke or primer. At this point the vehicle could probably be considered reasonably flexible, but was not necessarily completely warmed up.

The high-gear operation at the stabilization speed was continued to the point of complete flexibility, which was determined by making snap-throttle accelerations at 0.4-mile intervals and measuring the engine speed attained at the end of a 10-sec interval. The point of complete warmup was defined as the time interval from the engine start to the time for the first of three successive accelerations that

resulted in engine speeds that approached those obtained witn the same vehicle run previously in a completely warmed-up condition. A warmup time of 15 min was designated by the Ordnance Corps as the dividing line between satisfactory and unsatisfactory performance.

The starting technique was based on the procedure recommended in the military instructions for cold-weather operation. This technique would be considered severe, since it eliminates those tricks that drivers learn when living with individual vehicles. Similarly, the warmup technique is considered to be sufficiently severe and sufficiently indicative of field operations so that a vehicle that gives a reasonable warmup time by this technique may be considered satisfactory in actual service.

Test Results

The performance of all of the vehicles tested on type A fuel is summarized in Table 1.

If we look first at warmup times for 0 F, we see that 11 out of the 13 wheeled vehicles were tested at this temperature; and they all warmed up well within the 15-min limit. With one exception, the tracklaying vehicles performed just as well. One of the Model I vehicles failed to warm up satisfactorily; although this vehicle was peculiarly sensitive to fuel volatility and gave perfectly satisfactory warmup on the type C gasoline.

When this program was first discussed, it was thought that a good many of the military vehicles to be tested might very well be in difficulty, in so far as warmup was concerned. Needless to say, it has been very gratifying to find that it does not seem to be a problem.

For starting times at 0 F, the wheeled vehicles performed reasonably well, although not quite so well as in regard to warmup. Models A, B, F, and G were completely satisfactory, even without the use of primers. Models C and E were not satisfactory without primers, although limited testing with primers appeared to indicate that both of these models could be brought into the satisfactory range by this means. The single vehicle of Model D did not start satisfactorily even with the use of a primer, and insufficient data were obtained on Model H to draw a conclusion.

None of the tracklaying vehicles gave very satisfactory starting performance on type A fuel at 0 F. Model J was somewhat better than the other two, but even it was borderline. Here, again, even though a number of the vehicles did not perform too well, the overall result of the starting tests has been somewhat more favorable than might have been expected, in view of World War II experience.

Table 2 summarizes the results at 0 and -20 F with arctic-grade fuel. Unfortunately, vagaries of the weather and, in certain cases, of the vehicles themselves, limited the amount of data that could be obtained. There was only one day in the entire test period of over two months that dropped below the desired -20 F. In consequence, data in this range are rather meager.

Only eight of the 18 vehicles were tested for warmup at -20 F; although all eight gave completely satisfactory performance. Even vehicle No. 2 of Model I, the one vehicle that did not warm up on type A fuel, did quite well on type C.

Starting followed the same general pattern as before. The six wheeled vehicles that were tested started satisfactorily. The two tracklayers that were tested would not start within the 15-sec limit.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Table 1—Starting and Warmup Time—Type A Fuel

Model	No.	Starting Time, sec		Warmup Time, min	
		0 F	32 F	0 F	32 F
		Wheeled Vehicles			
A	1	7	2	8	6
A	2	15	2	7	7
B	1	5	1	5	4
B	2	4	2	6	4
C	1	*	1	8	6
C	2	*	2	12	8
D	1	*	6	10	10
E	1	*	1	10	8
E	2	*	1	8	7
F	1	5	1	7	7
F	2	5	1	8	7
G	1	5	—	—	—
H	1	—	10	—	—
		Tracked Vehicles**			
I	1	*	*	6	6
I	2	*	7	*	5
J	1	18	2	10	4
J	2	15	3	8	4
K	1	*	3	8	7

* Unsatisfactory.
** All starts with primer.

Table 2—Starting and Warmup Time—Type C Fuel

Model	No.	Starting Time, sec		Warmup Time, min	
		-20 F	0 F	-20 F	0 F
		Wheeled Vehicles			
A	1	7	2	8	7
A	2	10	1	10	8
B	1	10	1	12	7
B	2	—	1	—	8
C	1	—	2	—	7
C	2	—	2	—	8
D	1	10	3	10	10
E	1	—	—	—	*
E	2	—	1	—	9
F	1	3	2	10	8
F	2	4	2	11	9
G	1	—	2	—	6
H	1	—	6	—	9
		Tracked Vehicles**			
I	1	—	—	—	—
I	2	*	*	13	8
J	1	—	—	—	—
J	2	*	10	10	6
K	1	—	—	—	—

* Unsatisfactory.
** All starts with primer.

Custom-Tailored Lubes

TAILORING a lubricating oil to fit service conditions really helps keep vehicle oil mileage up. That's because custom-tailored oils reduce oil ring clogging and cylinder wear . . . and these are the things that cause high oil consumption.

It's all just a matter of tailoring lubricating oils to fit vehicle operating conditions, engine design, and fuel type. And the new API classification for lubricating oils opens the way to just that.

This new system eliminates the classification of crankcase lubricants based on oil characteristics and provides instead a classification of service requirements. It defines five types of service conditions—MS, MM, and ML for gasoline or other spark ignition engines, and DG and DS for service typical of diesel engines. Just what these service definitions mean in the way of actual vehicle operating conditions is shown in the accompanying box. Ac-

API's New Service Designations for Lube Oils
What they are . . . What they cover

Service MS—Normally the most severe service conditions encountered in gasoline engine operation, including:

- Low operating temperature, start-stop driving typical of city traffic conditions.
- Operation under milder service than that described above of engines which, because of design features, are critical to deposits.
- Sustained high-temperature, high-speed driving typical of over-the-road heavy-duty trucking.

Service MM—A more moderate service condition than Service MS. It is typical of normal highway operation of passenger cars. Vehicles powered by engines which are relatively insensitive to deposit formation under high-speed and heavy-load conditions are included in this service, especially when operated with fuels of favorable characteristics.

Service ML—Least severe service condition, such as may be encountered in operation of passenger cars at moderate speed and normal engine temperature. It excludes new high compression ratio engines with such refinements as hydraulic valve lifters or other parts sensitive to deposits.

Service DS—The most severe service conditions encountered in diesel engine operation, including:

- Operation of engines on fuels of high sulfur content or abnormal volatility.
- Operation of engines under continuous low temperature and light load, or extremely high-temperature, high-load conditions.
- Engines which, because of design features, are critical to wear or deposits.

Service DG—Diesel engine operation on low to moderate sulfur content fuels of normal volatility under normal engine operating temperatures and load. This service is typical of most trucking and farm tractor operating conditions.

Are a Tonic to Engines

J. A. Miller and B. M. Berry
California Research Corp. Standard Oil Co. of Calif.

Excerpts from paper, "Tailoring Lubricating Oils to Fit Service Requirements" presented at SAE National West Coast Meeting, San Francisco, Aug. 13, 1952.

tually, however, nothing prohibits the use of an oil for more than one service, providing it is suitable for each.

How to Custom-Tailor an Oil

How can an oil be tailored to meet service requirements as defined in this new API classification? This can best be illustrated by tracing the development of an oil "For Service MS."

First step in the development of this oil was to determine why passenger-car engines operated under typical MS service conditions were being overhauled . . . and to what extent overhauls were necessitated by lubricating oil performance. Therefore, such information was compiled on cars operated predominantly in city-traffic and high-speed, cross-country driving. The results of these surveys showed that:

1. High oil consumption was the major factor influencing a vehicle owner's decision to have his engine overhauled.
2. Except where mechanical failures occurred, high oil consumption was caused by oil ring clogging and/or cylinder wear.
3. Start-stop, low operating temperature driving is the most severe encountered in passenger-car operation. It is conducive to oil ring plugging and engine wear which, in turn, ultimately lead to need for engine repair.
4. An oil to meet lubrication requirements of this type of service should keep wear down and retard

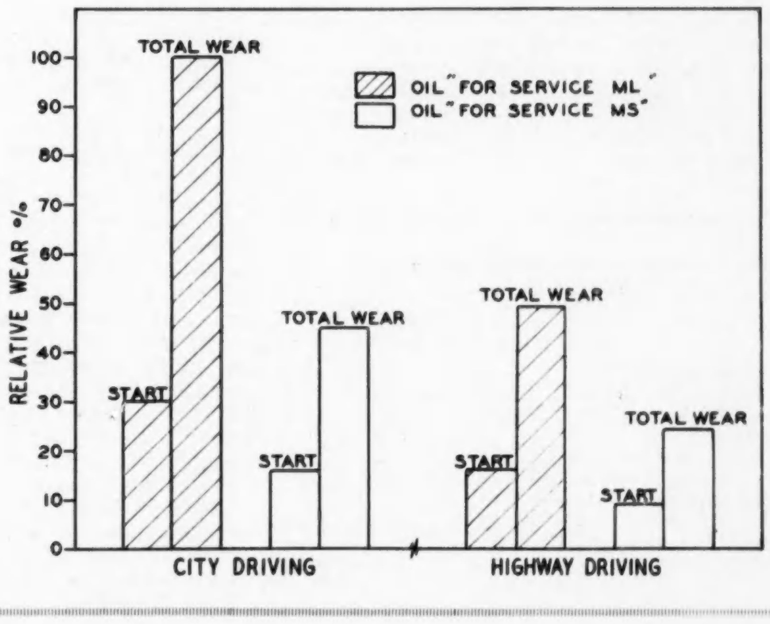


Fig. 1—Much less engine wear results when crankcase oils are tailored for a specific service. These bar graphs show, for example, that an oil designed specifically for city-traffic and highway driving gave far less engine wear than one designed for less severe service conditions

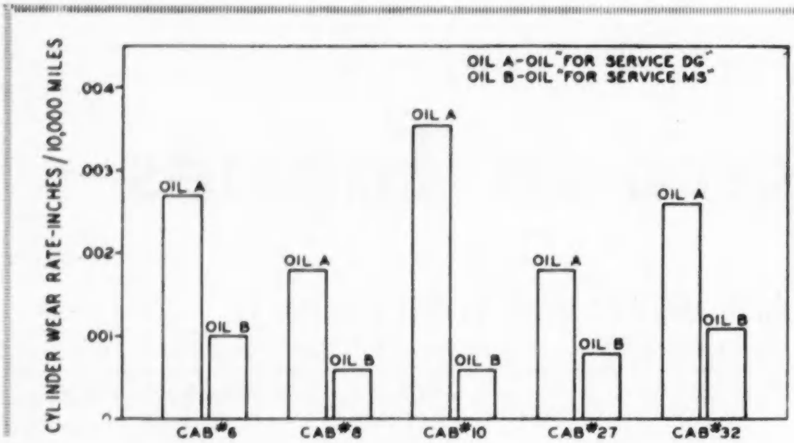


Fig. 2—Further evidence that custom-tailored oils do a better job is illustrated by this data obtained on taxicab engines. Here oils A and B were of the same additive level, but oil A was actually designed for diesel not for gasoline engine service

formation of deposits, particularly in the ring belt area.

Having established the requirements for a lubricating oil for passenger-car operation in city-traffic driving, a program was initiated to develop an oil which would control wear and deposits under this "Service MS." The radioactive tracer technique was used to study the effect of operating variables and lubricating oil type on engine wear.

Fig. 1 shows the results of radioactive ring wear tests made to compare the control of engine wear by oils of different types under city and highway driving conditions. (The data presented were obtained with an oil "For Service ML" and with another oil which laboratory tests indicated to be satisfactory "For Service MS.") The chart shows the wear on starting, and during city and highway driving with the two oils, as a percentage of the wear observed in city-traffic operation with the oil "For Service ML."

It will be noted that traffic driving caused approximately twice the wear that occurred in an equivalent amount of highway operation. Also starting accounted for approximately one-third of the total wear under both types of operation. What's more, it can be seen that reduction in wear varied with oil type. The data shown, then, are representative of the improvement in wear reduction which can be achieved through designing oils for a specific service.

Confirmation of these test results was obtained in a fleet of taxicabs in which the performance of an oil "For Service MM" was compared to that of an oil "For Service MS." The test engines were inspected after 30,000 miles of operation, at which time testing of the oil "For Service MS" was continued for an additional 30,000 miles.

The results of these tests are summarized in Table 1. These data show that at 60,000 miles the wear and deposits in engines operating on the oil "For Service MS" were essentially the same as those observed in the reference engines after only 30,000 miles of operation.

In this particular fleet, overhauls were made when oil consumption exceeded 1 qt per day (approximately 150 mpq), which usually occurred after 35,000 to 50,000 miles of service. On this basis, then, the oil "For Service MS" doubled the effective life of the engines. In fact, this fleet now operates on this type of oil, and it is reported that the average overhaul period has increased to 75,000 to 100,000 miles.

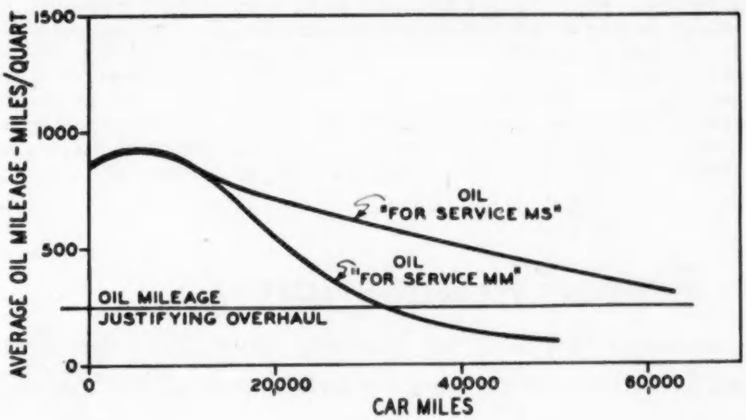
In still another taxi fleet, the performance of the oil tailored "For Service MS" was compared to that of an oil of approximately the same additive level designed for diesel engine service. (Under the new API system, this oil undoubtedly would be considered suitable "For Service DG.")

The wear rates of the two oils are presented in Fig. 2, where oil A is the reference oil and oil B is the oil tailored "For Service MS." (In this test five cabs were operated for approximately 30,000 miles on oil A. The engines were then inspected, rebuilt, and operated for an additional 30,000 miles on oil B.) The greater effectiveness of oil B in controlling wear is readily apparent. Deposit control was also found to be superior for oil B, and the condition of the engines was similar to that shown for the oil "For Service MS" in Table 1 at 30,000 miles. These results illustrate a very important point, namely, that it is not safe to assume that oils of the same additive level will perform equally well in different types of service.

Table 1—Comparative Performance of Oils in Taxicab Service

	Oil Type		
	"For Service MM"	"For Service MS"	
Nominal Test Mileage	30,000	30,000	60,000
Valve Chamber Sludge	Heavy	Medium	Heavy
Crankcase Sludge	Light	Light	Light
Oil Screen Clogging, %	30	5	43
Oil Ring Clogging, %	80	42	73
Average Cylinder Wear, in.	0.0060	0.0035	0.0071
Average Cylinder Wear Rate, in./10,000 miles	0.0020	0.0012	0.0012
Average Oil Consumption miles/qt	300	700	300

Fig. 3—An oil tailored for city-traffic driving gave far better oil mileage in a fleet of taxicabs than one designed for less severe service



Oils designed to control deposits and wear under low operating temperature, start-stop service may also be designed to perform satisfactorily under high-load, high-temperature service. This fact was established in several heavy-duty gasoline engine truck fleets. For example, the average wear rate observed in one fleet using an oil "For Service MS" was only 0.0026 in. for 80,000 miles of operation. What's more, these engines were extremely clean, average oil ring clogging was approximately 15%, and oil screen clogging was less than 5%. Similar performance has also been observed with this type of oil in other gasoline-powered truck and bus fleets.

Summing up, then, the data presented show that low-temperature, start-stop driving is indeed a severe type of gasoline engine service. And the most important advantage to be gained through reduction of engine deposits and wear by using an oil tailored to meet this severe condition is maintenance of satisfactory oil mileage for relatively long periods. This advantage is illustrated in Fig. 3 which compares typical oil consumption histories for passenger-car engines operated in city traffic with an oil tailored "For Service MS" and one designed "For Service MM." (These data were obtained during the taxi fleet tests previously discussed.)

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Excerpts from Discussion

J. A. Edgar, Shell Oil Co.

THE authors have indicated clearly that much waste can be stopped if a lubricating oil is designed properly for the service intended. This discusser feels impelled to add, however, that "service" is composed of two elements—mechanical severity and time. An oil compounded to prevent wear can do so very successfully under severe conditions for a moderate time, or under moderate conditions for a long time. This is because antiwear additives charge recklessly into the battle against corrosion, and sustain casualties in proportion to the strength of the enemy. Sooner or later the antiwear property becomes depleted, and the oil is no better off from then on than the base mineral oil carrier.

Fig. A shows what happens to a strongly antiwear oil under conditions which are mechanically moderate, but which become severe timewise. A high degree of protection exists for 50 hr or 2000 miles. Beyond that, however, the defense collapses rapidly, and in an extra 500 miles the engine is worn nearly

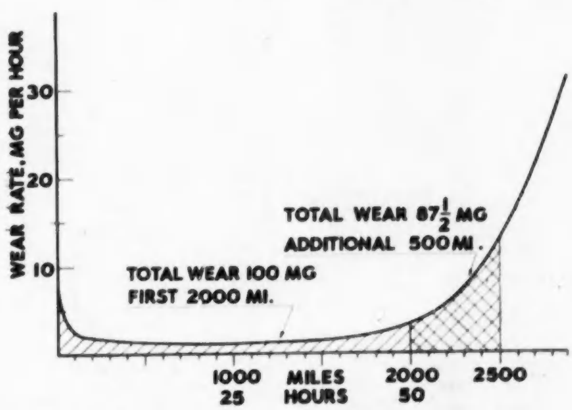


Fig. A—This shows what happens to a strongly antiwear oil under conditions which are mechanically moderate, but which become severe timewise

as much as it was in the first 2000 miles. If the service had been mechanically severe, that is, with many starts and/or with a low engine temperature, then the antiwear property of the oil would have disappeared sooner.

Improvements in filtration equipment have been expected to extend the antiwear life of crankcase oil, thereby allowing oil drain periods to be extended. But corrosive wear, which can be reduced only by chemical means, is added to mechanical wear, and is by far the greater of the two in the cylinder zone.

Hence a good rule is to adjust oil drain practice to the chemical properties of oil . . . and to accept cleanliness as a bonus. The direct cost of oil and filter will be less because the filter will last longer, and there will be a saving in engine life in the hundreds of dollars, as the mileage figures of the authors show.

Jet Power Installation . . .

. . . demands coordination between engine and airframe producers in early design stages. Fairing with converging-diverging nozzle is a case in point.

Based on paper by **William H. Hand** North American Aviation, Inc.

UNDER most conditions, jet-engine thrust is dependent to a very great extent on the performance of the inlet duct and the exhaust nozzle. The goal, therefore, is to design these parts so that, when installed in an airplane, the maximum sum of thrust less drag will be obtained.

In the case of the nozzle, the value of thrust coefficient obtainable should be balanced against the base pressure drag and fairing drag resulting from the nozzle configuration. The sketches in Fig. 1, which show the base pressure area for three nozzle configurations, illustrate this concept of base pressure drag.

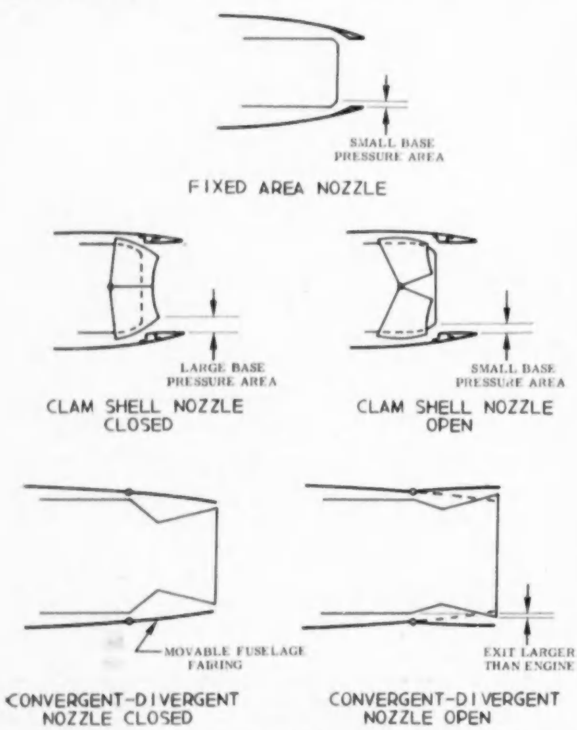


Fig. 1—Base pressure area for three typical nozzle-airplane exit fairing configurations

In a high speed body this blunt discontinuity of the fuselage or nacelle creates a low-pressure region which, applied to the area presented to this pressure, results in a negative force or drag on the plane. The base pressure area is a function of how well the airplane lines can be faired to the nozzle exit, which, in turn, is a function of the nozzle shape and injector pump requirements if such a device is used. With the clam-shell type of variable area nozzle it is almost impossible to get a good fairing, with or without an ejector pump.

This fairing problem promises to be even more difficult with the converging-diverging type of nozzle, as the area change of the exit can be several times that required for the simple converging nozzle. In fact, in the near future we will be faced with conditions of high speed where the nozzle exit area required for complete expansion of the exhaust gases is larger than the engine. Such a case is illustrated in the lower right hand corner of Fig. 1. (Paper, "The Power Plant Installation as a Mutual Engine-Airframe Problem," was presented at SAE National Aeronautic Meeting, Los Angeles, Oct. 3, 1952. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers).

Based on Discussion by D. F. Jamison, General Electric Co.

MUCH can be gained by an increased exchange of aircraft components for simulated installation testing by the engine manufacturer long before actual flight tests are started. However, as operating speeds increase and more complicated installation devices, such as variable-geometry inlets and converging-diverging nozzles, are required, the effects of installation components on engine and aircraft performance will be even more critical. Consequently, the potential benefits from proper matching engine and airframe will increase. These possible gains in performance and operating efficiency will require greatly increased coordinated design and testing activity between engine and aircraft manufacturers.

NEWS OF SAE

pages 79--87

TULLAHOMA TOUR . . .

. . . planned for SAE members interested in Arnold Engineering Development Center in south central Tennessee.

A TOUR of the Arnold Engineering Development Center near Tullahoma, Tennessee will be held April 24 as the final event of the SAE National Aeronautic Meeting, following the Aeronautic Production Forum and three days of technical sessions held in New York.

SAE members taking the tour may see all of the extensive facilities and buildings at the Center. At the Engine Test Facility members will be shown equipment for testing all sizes of turbojet and ramjet powerplants under simulated flight conditions and altitudes up to 80,000 ft. The facility has three altitude test chambers and a test bed. Its air-handling capacity is greater than any other similar laboratory in the nation. It is expected that the equipment will be in actual operation by the date of the SAE tour.

Also on display will be the Gas Dynamics Facility designed to test models of aircraft and guided missiles and their components in the supersonic and hypersonic speed ranges. It will have two continuous 40 × 40-in. test sections and two intermittent 12 × 12-in. test sections. Electric motors to furnish the approximately 90,000 hp it takes to operate the large sections are being installed. The smaller sections are further along and are expected to be in operation sometime in March.

Third major facility to be shown is the Propulsion Wind Tunnel designed for developmental testing of full-scale operating ramjet and turbojet powerplants installed in missiles and aircraft. It will include a transonic and a supersonic circuit, both driven from one set of drive motors of over 200,000-hp capacity. Test sections in both circuits will be 16-ft square. The motor building has been erected together with an overhead crane way and a 150-ton crane. Portions of the transonic tunnel are in place and the supporting buildings are partly erected. A 1-ft. square model of the test section of the transonic circuit has been operating since October 1952.

As an introduction to some of the work going on at the Tullahoma facilities, G. W. Newton will present a paper on "Simulated Flight for Engines at AEDC" on Wednesday afternoon, April 22, two days before the tour, at an Aeronautic Meeting session at the Statler in New York. Newton works for ARO, Inc.—the firm which operates some of the Tullahoma test equipment for the Air Force—as chief of the Engine Test Facility.

The U. S. Air Force extends its invitation to make this tour to all SAE members. To attend, a member should apply to SAE headquarters, 29 West 39th St., New York 18, N. Y. by March 10. No security clearance is needed. Cameras will not be permitted on the site.

SAE will arrange a special charter flight for members wishing to fly between New York and the AEDC if sufficient applications for the flight are received. Plans call for buses to leave the Statler at 6:00 a.m. to get passengers at LaGuardia Airport in time for a prompt 7:00 a.m. take-off. Breakfast will be served during the flight. The tour will last from 10:30 a.m. to 4:30 p.m. The return flight is scheduled to arrive at LaGuardia at 10:10 p.m., and buses will return the group to Manhattan by about 11 p.m.

For those not using this charter flight, there will be buses leaving The Hermitage hotel in Nashville at 8:00 a.m. and Berry Airport at 8:30 a.m. for the AEDC. At the end of the tour, around 4:30 p.m., the buses will call for their passengers and deliver them back to Berry Airport and The Hermitage at about 6:30 and 6:45 p.m., respectively.

The Air Force has asked SAE to restrict admission to the tour to SAE members because of the limited facilities for guests at the Center.

ROTATION . . .

. . . of committee membership is being recommended by SAE administrative committees.

RECOMMENDATIONS from the Society's administrative committees on possible rotation of committee memberships are expected to reach SAE Council at its next meeting in Cleveland, on March 25. By that time, it was reported to Council on January 16, the committees that have not yet considered the question (raised by the Council a year ago) probably will have done so.

Council's suggestion that various forms of rotation of committee personnel be considered was based on two major thoughts:

1. Any SAE member benefits from participation in committee work. It is desirable, therefore, to permit participation by as many members as possible—where this can be done without impairing the effectiveness of the committee;

2. For a committee to remain strong, it is essential that replacements be available for members who have become inactive or who have actually left the committee.

Favorable Council action on the various recommendations would probably take the form of amending various by-laws to make the new systems officially operative. By-law changes require presentation for discussion at two successive Council meetings, so, the earliest the proposed changes could become effective would be with the appointment of the 1954 administrative committees.

Possibilities of devising satisfactory means of assuring "rotation" on other-than-administrative committees (such as the various Professional Activity Committees) are scheduled for further Council discussion and consideration in the months to come.

HIGH-TEMPERATURE . . .

. . . aircraft hydraulic systems to get deep probing at Spring Aeronautic Meeting.

SO terrific is the interest in high-temperature aircraft hydraulic systems today that information-hungry engineers flock by the hundreds to every meeting of SAE Committee A-6, Aircraft Hydraulic and Pneumatic Equipment.

Now, thanks in part to A-6's decision to cosponsor 10 papers at the April SAE National Aeronautics Meeting with the SAE Aircraft and Air Transport Activities, a lot more SAE'ers and guests will get a chance to find out:

- WHAT are the limitations of synthetic rubber packings?
- WHAT requirements do high-temperature hydraulic fluids have to meet?
- WHAT are the special problems introduced by high-temperature hydraulic systems in piloted aircraft and guided missiles?
- WHAT is being done to increase the reliability of existing and future aircraft hydraulic systems?
- WHAT pneumatic systems are used by the U. S. Air Force?
- WHAT is production and maintenance experience with high-pressure pneumatics in modern fighter aircraft?
- WHAT methods are used to predict pressure drop in pneumatic systems?

In short, by the time the chairman raps his gavel closing the last of three sessions, it's believed that few questions will be left unanswered—even though many problems will still remain unsolved.

Three men helped make possible this rich harvest of information—Weatherhead's B. R. Teree, A-6 chairman; Pan American's Scott Flower, SAE Air Transport's Meetings Vice-Chairman; and SAE Aircraft Activity Meetings Vice-Chairman J. D. Redding, Research and Development Board, Department of Defense. They planted the seeds that blossomed out into the 10 information-ripe papers.

TEXAS . . .

. . . steps up SAE activity. "Texas Gulf Coast" is new Section; Texas Section expands too.

SAE has been picking up fast down Texas way of late. With the endorsement of the Texas Section (which has been growing since 1942), Council has just approved establishment as an independent Section the former Houston Division of the Texas Section. Effective June, 1953, the new Section will be known as the Texas Gulf Coast Section.

At the same time, Council approved addition of a new Regional Vice-Chairman to the elective officers of the Texas Section to represent its recently established San Antonio Division.

CLICK . . .

. . . is key word in title of new SAE manual on operation of Student Branches.

"HOW to Make a Student Branch Click" is the title and purpose of a new SAE Student Committee booklet. It has gone to all Student Branch Chairmen, Faculty Advisers, and those engaged in Section student work. Its aim is to answer questions and to give helpful suggestions on operating student groups.

Manual Has 3 Main Sections

This first edition, an attractive 28-page booklet, has three main sections following a brief foreword and introduction. Part I, "How to Organize a Student Branch or Club," details necessary organization steps, shows how SAE Sections help SAE Student Branches and tells students about the SAE Placement Service.

Part II, "How to Make the Student Branch or Club Click," expands the main theme of the booklet and gives practical, usable "how-to-do-it" ideas for Student Branch operators. Part III, "From Student Enrollment to SAE Member," clarifies the easy-to-take steps involved in this process and shows the student how to get the most from his SAE membership.

With this first edition off the press, the Committee is already looking forward to a second edition. In it will be incorporated ideas and suggestions received from SAE users of the ideas given in the booklet.

This Trio Planted the Seeds that Will Feed Information-Hungry Engineers

B. R. Teree
Chairman, Committee A-6

Scott Flower
Meetings Vice-Chairman, Air Transport

J. D. Redding
Meetings, Vice-Chairman, Aircraft

They laid the groundwork that led to the presentation of 10 papers ripe with information about aircraft hydraulic systems

Powwow of Production Forum Planners

At a recent meeting in New York, Dr. Michael Field, general chairman of the SAE Aeronautic Production Forum, briefed his panel leaders on the operation of a panel. He said that panel discussions are audience participation programs at which manufacturing men can discuss their problems with specialists on the panel.

Among those present at the meeting were (left to right above): H. Ford Dickie, General Electric, leader of the Manufacturing Management Panel; J. R. Douslin, Wyman-Gordon, secretary of the Large Forgings and Castings Panel; Dr. Michael Watter, The Budd Co., leader of the Precision Forming and Joining Panel; E. F. Gibian, Thompson Products, member of the Forum Executive Committee; K. W. Stalker, General Electric, leader of the Machining Panel; I. J. Keough, Republic Aviation, leader of the Machine Tools and Tooling Panel; Adam Hetzer, Republic Aviation, secretary of the Machine Tools and Tooling Panel; and G. W. Motherwell, Wyman-Gordon, leader of the Large Forgings and Castings Panel.

AERO MEETING . . .

. . . will feature advanced powerplants at all-day confidential sessions.

THE SAE National Aeronautic Meeting, April 20-24, will include a whole day of confidential sessions on turbojets, missiles, and rockets and a whole day of open sessions on aircraft hydraulic and pneumatic systems arranged with the cooperation of SAE Committee A-6, Aircraft Hydraulic and Pneumatic Equipment. In addition, there will be four other open sessions and on Thursday evening a dinner . . . besides the SAE Aeronautic Production Forum on Monday, April 20, the engineering display April 21-23, and the tour of the Arnold Engineering Development Center at Tullahoma, Tennessee on Friday, April 24.

Those wishing to attend the confidential sessions should fill out the forms mailed to them late in January and return them before March 15 to SAE headquarters. (Additional forms are available on request from the Meetings Division, Society of Automotive Engineers, 29 West 39th Street, New York 18, N. Y.) Air Force security officers are already processing forms which have been returned. Those cleared will receive admittance cards in the mails several weeks before the sessions.

On Tuesday, April 21, Navy and Air Force representatives will touch off the day of confidential sessions at 9:30 a.m. with a symposium on turbojet experience. The Army Nike surface-to-air missile, the Navy Regulus surface-to-surface missile, and the Air Force air-to-air missile will be discussed at the afternoon session, scheduled to begin at 2 p.m. The evening session, listed for 8 p.m., will cover both American and Russian rocket powerplants.

The open sessions on hydraulic and pneumatic systems will be held on Wednesday, April 22. Beginning at 9:30 a.m. there will be a symposium on high-temperature hydraulic systems. The 2 p.m. session will consider how to design for increased reliability in hy-

PRE-1945 . . .

. . . members of SAE Council now eligible for Appreciation Certificates.

SAE Council has just authorized the sending, on request, to Council members who served prior to 1945 the Certificate of Appreciation which has regularly been awarded since that date to Council members as their terms are completed.

As shown in the illustration, the certificate reads "This is to certify that (name) served with distinction as a (office held) of the Society of Automotive Engineers during (date) and to express in behalf of the Society deep appreciation for his efforts."

All past Council members will be notified directly of the availability of their certificates as soon as the necessary processing has been completed.

draulic systems. At 8 p.m., designers will take up problems with pneumatic systems.

Other open sessions at the Aeronautic Meeting will cover turbine engine testing, experience with the British Comet, factors influencing airplane costs, turbojet installation problems, cockpit standardization, and aviation fuel economy.

All these sessions will be held at the Hotel Statler, across the street from Pennsylvania Station, in New York City.

AUSTRIAN . . .

. . . engineers are guests of SAE Diesel Engine Activity Committee.

A RECENT conference between Austrian engineers and representatives of the SAE Diesel Engine Activity resulted in both groups acquiring a liberal education concerning diesel work in the other's country.

The Austrian Diesel Engine Industry Productivity Team is making a 5-week tour of American diesel engine industry. It is sponsored by the Austrian Government and Industry and the Mutual Security Agency.

SAE Diesel Activity representatives at the meeting were: John W. Pennington, 1953 SAE vice-president for the Activity, and executive engineer, Metal Products Division, Koppers Co., Inc., John Dickson, chief engineer, Diesel Engine Division, GMC; Ervin L. Dahlund, chief engineer, Fairbanks, Morse, & Co.; and H. F. Bryan, assistant development chief engineer, Industrial Power Division, International Harvester Co.

Although arranged mainly to apprise the Austrians of American diesel engine work, our engineers learned many interesting details about European practice. They found out, for instance, that many more small, single-cylinder and 2-cylinder diesel engines are built in Austria and other parts of Europe than in America because of the high price of gasoline in Europe, making the operation of gasoline engines too expensive a proposition over there. In America not only is gasoline relatively cheap and plentiful but small gasoline engines are built so economically. As a matter of fact, it was pointed out that in some cases injection equipment would be so expensive that it would cost more than the com-

EVERYBODY . . .

. . . has his own definition of meaning of SAE. Here's one by a fellow who has been close to Society people and problems for some time.

John Warner was talking informally at the first meeting of the 1953 SAE Council. He was talking of SAE—its organization, its procedures . . . and its people.

He seemed to be talking chiefly as one who has long participated in SAE's progress and pains, rather than officially as its Secretary and General Manager. At one point, he got to speculating on what SAE really means.

"Certainly," he said, "SAE means different things to different people . . . and different things to the same person at different times.

"So each member is constantly writing and rewriting his own definition . . . And it's the sum of those definitions that charts the course and progress of the Society from year to year."

Then he continued: "Like the rest of you, I keep writing and rewriting my own definition, too. But there is one concept of SAE that becomes more and more firmly fixed as part of every definition that comes to my mind . . . It runs something like this:

"SAE is a flesh-and-blood family of professional men engaged in related endeavors. Through it, they create and grow and advance **together.** ('Together' is the important word in that sentence!)

"As participating members of the family, they find ways to express usefully almost every individual talent they may have . . . Through that expression, they gain much satisfaction for their creative desires.

"By the nature of these opportunities, SAE is most rewarding to those who use it as a facility for giving of themselves for the benefit of others."

plete competing gasoline engine.

Our engineers also learned that Europeans don't put as high horsepower into trucks as we do—as required by state laws—so as not to obstruct traffic on hills. For example, in America a 100-hp diesel goes into a 1½-ton truck. In Europe it goes into a 4-ton truck.

John W. Pennington

The European Team sees little chance of reducing fuel consumption much below 0.41 lb per bhp-hr for truck diesels and 0.375 lb per bhp-hr for railroad diesels. The Americans believe, however, that as low as 0.32 lb per bhp-hr is a possibility in the future.

TOMORROW'S . . .

. . . . Production theme of Production Meeting in Cleveland this Month.

MANUFACTURING men will get a glimpse of what the future holds at the SAE National Production Meeting in Cleveland, March 25-27. (See program on pages 86-87.)

Among the crystal gazers will be Emil Gibian, chief industrial engineer of Thompson Products, Inc., and 1952 SAE vice president. Gibian will forecast developments in production techniques and manufacturing management controls that will be in use by 1963. He has been talking with leading industrialists and manufacturing executives and will report their expectations for production in the future.

Paul Miller, general chairman of the meeting, reports that the Production

Paul Miller

Forum panels, slated for the first day of the meeting, are loaded with outstanding production specialists from all parts of the country. Says Miller, "Here is an opportunity to get topnotch consultation on your manufacturing problems. The only price you pay is to put in an appearance at the sessions."

Pretty down-to-earth crystal gazing will be served up by D. S. Harder and D. J. Davis, of Ford Motor Co. They will take a realistic look at automation—what changes it will bring to the factory of the future and its management. One of the things manufacturing management will need is better forecasting tools. John D. Lathrop, of Arthur D. Little, and E. D. Minett, Radio Corp. of America, will tell how the operations research technique can be put to work in industry. They will show ways in which it can be used as an aid to the big problem facing executives . . . coming up with the right decisions.

Pretty advanced information on manufacturing techniques also will be disclosed by J. H. Friedman, of National Machinery Co., and H. H. Whittingham, Detroit Gear Division, Borg-Warner Corp.

Friedman will talk about hot and cold extrusions. He'll point out new developments in the extrusion field. Whittingham will spotlight unusual problems in machining automatic transmission parts. He'll illustrate his talk extensively with slides showing unique techniques for achieving high precision in high production quantities at low cost.

Plant trips will round out the Cleveland meeting. Tours of the Ford foundry and engine plant and Cadillac's tank plant will reveal some of the most modern and unique facilities in the industry.

Buses will be available for transportation from the Hotel Statler, where the meeting is being held, to the two plants. Arrangements also have been made for serving lunch at both plants. The price: $1.25 for the round-trip bus trip and $2.00 for the luncheon.

You'll Be Interested to Know That . . .

NORMAN P. MOLLINGER, of the Ladish Co., has been appointed general chairman of the 1953 SAE Tractor Production Forum, to be held in Milwaukee on September 14. W. A. Roberts, president of Allis-Chalmers, has agreed to serve as sponsor of the Forum.

★ ★ ★

THE 1954 SAE NATIONAL TRANSPORTATION MEETING will be held in Boston during the fall of '54. The SAE Truck & Bus Activity Committee and the SAE Transportation & Maintenance Activity Committee both agreed to this.

★ ★ ★

W. J. SWEENEY has been elected president of the Coordinating Research Council, Inc., succeeding C. E. Frudden who has retired from the CRC board of directors. Earle S. MacPherson has succeeded Mr. Sweeney as CRC vice-president. Sweeney is vice-president, research and development, Standard Oil Development Co. while MacPherson is vice president of engineering, Ford Motor Co.

L. L. Bower, chief engineer, Waukesha Motor Co., has been elected to succeed Mr. Frudden as a member of the Board of Directors. He has also been appointed a member of the Executive Committee.

SECTIONS . . .

. . . to get Activity help on possible authors and topics for Section sessions.

LEONARD Raymond, Sections Committee representative on the SAE Meetings Committee, has arranged for cooperation of Activity meeting groups with those responsible for arranging Section meetings.

According to a plan made by the Meetings Committee on January 13, assistance to Sections in obtaining good papers will be offered in two ways: (1) Activity Committee agenda will regularly advise those groups that Sections would appreciate their referring for Section consideration papers suitable for Section presentation; and (2) Raymond will let each Section chairman know he is free to call upon any one of the 12 Activity Committees for assistance in locating papers. To facilitate contacts, each Section chairman will be supplied with a list of the Vice-Chairman for Meetings of the 12 Activity Committees. (These names also appear in lists near the front of the 1953 Roster which went into the mails late in January.)

National Meetings . . .

Meeting	Date	Hotel
	1953	
PASSENGER CAR, BODY, and MATERIALS	March 3-5	The Sheraton-Cadillac, Detroit
PRODUCTION	March 25-27	Hotel Statler, Cleveland
AERONAUTIC PRODUCTION FORUM	April 20	Hotel McAlpin and Hotel Governor Clinton, New York City
and		
NATIONAL AERONAUTIC MEETING and AIRCRAFT ENGINEERING DISPLAY	April 21-23	Hotel Statler, New York City
SUMMER	June 7-12	The Ambassador and Ritz-Carlton Atlantic City, N. J.
INTERNATIONAL WEST COAST	Aug. 17-19	Georgia Hotel, Vancouver, B. C.
TRACTOR and PRODUCTION FORUM	Sept. 14-17	Hotel Schroeder, Milwaukee
AERONAUTIC MEETING and AIRCRAFT ENGINEERING DISPLAY and AIRCRAFT PRODUCTION FORUM	Sept. 29-Oct. 3	Hotel Statler, Los Angeles
INTERNATIONAL PRODUCTION	Oct. 29-30	Royal York Hotel, Toronto
TRANSPORTATION	Nov. 2-4	Conrad Hilton, Chicago
DIESEL ENGINE	Nov. 3-4	Conrad Hilton, Chicago
FUELS & LUBRICANTS	Nov. 5-6	Conrad Hilton, Chicago
	1954	
ANNUAL and ENGINEERING DISPLAY	Jan. 11-15	The Sheraton-Cadillac and Hotel Statler, Detroit

Program for

1953 SAE National Production

Wednesday, March 25

Production Forum

Chairman—**PAUL A. MILLER,** The Leece-Neville Co.

Eight separate informal gatherings to exchange information and experience on vital production problems. Each group will have a panel of experts available all day to answer questions. Come early; quiz the experts; and go home with the answers.

ALL PANEL DISCUSSIONS 10:00 A.M. TO 12:00 NOON
2:00 P.M. TO 4:00 P.M.
Mezzanine, Ballroom Floor

Quality Control:

Organizing for the control of quality, to get maximum participation of all elements of a modern manufacturing organization in the quality problem, will keynote the discussion. Application of statistical techniques and new inspection tooling in modern manufacturing processes will be of interest to all in the field of production.

Panel Leader:

E. Gray, Director of Quality Control, The White Motor Co.

Panel Secretary:

F. Galbos, Assistant Chief Inspector, The White Motor Co.

Panel Members:

J. M. Juran, Consulting Management Engineer, New York University
R. S. Saddoris, Director of Quality, A. O. Smith Corp.
H. Weissbrodt, Works Manager, International Harvester Co.
W. H. Smith, Manager, Analysis Dept., Quality Control Manufacturing Staff, Ford Motor Co.
C. O. Gossom, Quality Control, Chevrolet Div., General Motors Corp.
James Rayer, Staff Supervisor—Quality, The Timken-Detroit Axle Co.

Production Control:

Discussion on accepted practices of stocking, handling, control, and flow of raw material and work in process stock. Production control as required with expanding industry for production of tomorrow.

Panel Leader:

D. S. Kimball, Jr., General Manager, Bendix-Westinghouse Automotive Air Brake Co.

Panel Secretary:

Russell Wetzel, Production Sales Manager, Bendix-Westinghouse Automotive Air Brake Co.

Panel Members:

Eric Thompsett, Factory Manager, Valve Division, Eaton Manufacturing Co.
C. F. McElwain, Works Manager, International Business Machine Co.
A. C. Schliewen, Factory Manager, Mack Manufacturing Corp.
J. E. Adams, Director Purchases and Planning, The White Motor Co.
R. C. Stupp, Plant Manager, Oliver Corp.

Grinding and Cutting Tools:

This panel will deal with current grinding practices in the automotive and aircraft industry, particularly in the engine parts manufacture. Also, present-day practices employed by the industry on design, use, and maintenance of cutting tools.

Panel Leader:

A. Karabinus, Assistant Division Manager, Valve Div., Thompson Aircraft Products, Inc.

Panel Secretary:

W. D. Achor, Valve Quality Control Coordinator, Thompson Products, Inc.

Panel Members:

J. L. Bunce, Factory Manager, Pratt & Whitney Aircraft Div., United Aircraft Corp.
George Pascoe, Manager, Design and Standards Dept., Manufacturing Engineering Office, Ford Motor Co.
J. G. Gaul, The Cleveland Pneumatic Tool Co.
W. B. Shimer, Assistant Master Mechanic, DeSoto Div., Chrysler Corp.

Foundry:

Techniques developed to cope with increased demands on the foundry industry. What is the latest development regarding foundry? Practices required for mass production. Attend this panel for the answers.

Panel Leader:

E. C. Jeter, Plant Manager, Ford Motor Co.

Panel Secretary:

J. Stirling, Supervisor of Training Section, Ford Motor Co.

Panel Members:

Al Hinton, Plant Manager, Cleveland Sand Foundry, Aluminum Co. of America
Alex Barczak, Works Manager, Superior Foundry Inc.
William Phillips, Sales Manager, Crucible Steel Casting Co.
F. J. Pfarr, Plant Manager, Lake City Malleable Co.
Frank O'Malley, Personnel Director, Ferro Machine & Foundry, Inc.

Forgings:

Current manufacturing techniques necessitated by changing configuration and improved performance require new methods to cope quickly with the problems created by these trends. Maintenance of costs at minimum also will be presented and discussed.

Panel Leader:

C. H. Smith, Jr., President, Steel Improvement and Forge Co.

Panel Secretary:

Raymond Seabury, Secretary-Treasurer, Drop Forging Assn.

Panel Members:

T. E. Darnton, Assistant Works Manager, Oldsmobile Forge Div., General Motors Corp.
R. E. Hess, Factory Manager, Transue and Williams Steel Forging Corp.
F. A. Rood, Master Mechanic, Chevrolet Forge Div., General Motors Corp.
R. G. Friedman, Vice President, National Machinery Co.
E. C. Clarke, Jr. Vice President and General Manager, Chambersburg Engineering Co.

Material Handling:

Is quantity production required for efficient material handling? Cost reductions with correct material handling. This panel will offer suggestive corrections for material handling problems.

Panel Leader:

H. O. Horning, Material Handling and Packaging Engineer, Staff Masters Mechanics Div., Chrysler Corp.

Panel Secretary:

S. D. Sanders, Administrative Consultant, The Leece-Neville Co.

Panel Members:

Harry Diefendorf, Consultant and Material Handling and Package Engineer
D. W. Kelsey, Material Handling En-

Meeting and Forum

Hotel Statler, Cleveland, March 25-27

gineer, Union Steel Products
Al Blatz, Material Handling and Package Engineer, A. O. Smith Corp.
A. Hancox, Plant Layout Engineer, Cleveland Graphite and Bronze Co.

Preventive Maintenance of Plant Equipment:

The relationship of preventive maintenance to production planning is controlled costs.

Panel Leader:
W. J. Collier, Plant Engineer, Thompson Products, Inc.

Panel Secretary:
Anthony Lucian, Industrial Engineer, Thompson Products, Inc.

Panel Members:
I. N. Tull, Superintendent, Electrical Dept., Republic Steel Corp.
S. H. Janeski, Master Mechanic, Ladish Co.
Jim Solomon, Chief Engineer, National Machinery Co.
Leo Milan, Chief Plant Engineer, Douglas Aircraft Co., Inc., Tulsa Plant

Progressive Assembly Technique and Methods:

A review of economics and mechanics of present-day progressive assembly techniques as practiced in the various branches of the automotive industry.

Panel Leader:
W. L. McCarthy, Assistant Factory Manager, Delco-Remy Div., General Motors Corp.

Panel Secretary:
H. G. Riggs, Starting Motor Plant Superintendent, Delco-Remy Div., General Motors Corp.

Panel Members:
L. E. Drum, Works Manager, International Harvester Co.
D. Dowling, Superintendent, Assembly, Cummins Engine Co.
W. B. Terbeek, Works Manager, The White Motor Co.
George Bluth, General Chief, Inspection, Willys-Overland Motors, Inc.

Thursday, March 26

9:30 a.m. — **Euclid Ballroom**

"Welcome"—**Paul A. Miller**, General Chairman of Meeting
"Production Tomorrow"
E. F. Gibian
1952 SAE Vice-President for Production Activity
Chairman—**R. F. Steeneck**, Fafnir Bearing Co.
Secretary—**A. D. Gilchrist**, The Leece-Neville Co.

The Automatic Factory?
D. S. Harder and **D. J. Davis**, Ford Motor Co.
Automation promises faster production at lower cost with greater safety, but cannot eliminate thinking. Automation programs must comprehend manpower reallocation, control, maintenance, economics, and other pertinent factors.

Hot and Cold Extrusions
J. H. Friedman, President, National Machinery Co.
Through hot and cold extrusion dies pass the world's most famous forgings! Old yet ever-new technique, it is essential to military, automotive, agricultural, and industrial production; source of countless, complicated components of industry.

2:00 p.m. — **Euclid Ballroom**

Chairman—**H. S. Highet**, Cleveland Graphite Bronze Co.
Secretary—T. R. Thoren, Thompson Products, Inc.

Operations Research as Applied to Industrial Production and Development
J. B. Lathrop, Arthur D. Little, Inc., and **E. D. Minett**, Radio Corp. of America
Operations research is helping management to make correct and constructive decisions. Present uses include evaluating new developments, production scheduling, and determining cost factors in machine operation.

Unusual Problems in Machining Automatic Transmission Parts
H. H. Whittingham, Detroit Gear Div., Borg-Warner Corp.
Out-of-the-ordinary requirements call for unusual operations and techniques in producing highly precisioned parts for automatic transmissions. Slides show how high production at low cost still is possible.

5:45 p.m. to 6:45 p.m. — **Ohio Room**

Reception

SAE Cleveland Section—Host

7:00 p.m. — **Grand Ballroom**

Dinner

Paul A. Miller,
General Chairman of Meeting

E. K. Brown,
Vice Chairman, SAE Cleveland Section

A. T. Colwell
Toastmaster

"Preparedness and Production"
ROBERT CASS, SAE President
and
Assistant to President The White Motor Co.

Friday, March 27

Plant Tours

9:30 a.m. to 12:00 Noon

Group 1 . . . . Cadillac Tank Plant
Group 2 . . Ford Foundry and Engine Plant

1:30 p.m. to 4:00 p.m.

Group 1 . . Ford Foundry and Engine Plant
Group 2 . . . . Cadillac Tank Plant

Special buses will pick up and return the groups to the Hotel Statler. Luncheon will be served at respective plants.

Round-trip bus	$1.25
Luncheon	2.00
Total	$3.25

Tickets and additional information may be obtained at Registration Desk during meeting.

About

Members

H. M. TAYLOR has been elected vice-president in charge of manufacturers sales of the Firestone Tire and Rubber Co., Akron, Ohio. Taylor joined Firestone in 1915, and has been with the manufacturers sales staff since 1921. He has been manufacturers sales manager since 1944.

GEORGE J. HUEBNER, JR., has been named executive engineer in charge of Chrysler Corp.'s guided missile project for the Army. Huebner was previously chief engineer for research.

LAWRENCE H. FLORA has been named director of engineering of Tinnerman Products, Inc., Cleveland. He has been with Tinnerman since 1942, and was head of the development department until becoming chief engineer in 1949.

DAVID S. BURNETT has been named sales manager of the automotive division of Detroit Steel Products Co., succeeding **SAMUEL P. HESS,** who has retired after 40 years' service with the company. Burnett has been assistant sales manager of the division since joining Detroit Steel Products a year ago.

A. E. KIMBERLY has been named chief engineer of DeSoto Division of Chrysler Corp., and **ROBERT ANDERSON** has been named chief engineer of Chrysler's Plymouth Division. Kimberly was previously staff engineer in charge of mechanical laboratories in Chrysler's engineering division, and Anderson was assistant body engineer for the engineering division.

LYSLE A. WOOD, Boeing Airplane Co. chief engineer since 1948, has been named to the newly-created post of director of pilotless aircraft. Wood, who joined Boeing in 1926, was assistant chief engineer for five years before becoming chief engineer, and prior to that headed the project groups responsible for the design of the Boeing Stratoliner and Model 214 flying boat.

CURT H. GARMAGER is now director of engineering for Rockford Clutch Division of Borg-Warner Corp., Rockford, Ill. Garmager was previously with Dearborn Motors Corp., Birmingham, Mich.

PERCY L. BARTER has retired as first vice-president of McCord Corp., Detroit, and is now living in Salisbury, Conn. Barter first joined the McCords in Chicago in 1906, and moved to Detroit in 1909 when the corporation was established there, serving as sales manager and later vice-president until his recent retirement. He has been an SAE member since 1913.

JOHN W. WEAVER has been named sales manager of the Casting Division of Waukesha Foundry Co., Waukesha, Wis. He has been with the company's sales department for the past 18 years.

Back Together Again . . .

HAROLD S. VANCE (right), chairman and president of the Studebaker Corp., has announced that **PAUL G. HOFFMAN** (left), former president of the company, who resigned Feb. 4 as head of the Ford Foundation, has returned to Studebaker as chairman of the board of directors.

Vance, who will continue as president and chief executive officer of Studebaker, pointed out that Hoffman has been associated with the company for 38 of the past 42 years.

In 1935 Hoffman was named president and Vance was named chairman. They served together until 1948 when Hoffman was granted leave of absence to become the first administrator for the Economic Cooperation Administration. In 1950 he became president of the Ford Foundation and for the past two years has directed the affairs of that organization.

Hoffman resigned his Ford post because the trustees of the Ford Foundation had decided to consolidate operating functions of the Foundation in the East. He plans, however, to devote such time as he can to some of the important Ford Foundation projects now under way and lend whatever advice and assistance the trustees and administrative officers may desire.

J. EDWARD TAYLOR has been named director of automotive engineering division, one of two new divisions of Gulf Research and Development Co., Pittsburgh, Pa. Taylor was previously a member of the product development and product engineering department. **CHARLES W. BUTLER** and **R. L. KIRKPATRICK** were named assistants to the director of automotive engineering. Butler was previously chief automotive engineer, and Kirkpatrick was assistant chief automotive engineer.

OSBORN H. CILLEY has been named general manager of the U. S. Asbestos—Grey-Rock Division of Raybestos-Manhattan, Inc., Manheim, Pa. Cilley is also a vice-president and director of the corporation. He has been with the division since 1920.

VICTOR A. OLSEN has retired as general manager of GMC's Detroit Transmission Division after 37 years of service with General Motors Corp.

K. E. COPPOCK, assistant chief engineer of GMC's Fisher Body Division, has been elected president of the American Society of Body Engineers for the coming year, and **A. F. DEBICKI**, styling representative for the Fisher Body engineering division, has been elected to the Society's board of directors.

T. K. GREENLEE has been named chief electro-mechanical engineer for Lear, Inc., Grand Rapids, Mich. Greenlee was previously chief engineer of the Barber-Colman Co., in charge of actuator and controls development. He is a member of SAE's Committee A-9 on aircraft air conditioning.

T. A. LaBRECQUE has been elected a vice-president of the Hilliard Corp., Elmira, N. Y. He will continue as manager of Hilliard's purifier division in charge of sales and engineering. LaBrecque has been associated with the corporation since 1926.

CHARLES H. JUDD is now president of the new firm of Judd Industries, Inc., Cleveland, Ohio. Judd was formerly general manager of the Reid Products Division of the Standard Products Co. and Multiple Products, and has been a director of Lamson and Sessions Co. since 1946. He has previously served as chief engineer of Tinnerman Products, Cleveland, vice-president of the Prestole Corp., Toledo, and stamping adviser to Simmonds Accessories, Ltd., in London and Paris.

Sun Oil Promotions

Clayden

Moxey

A. L. CLAYDEN has been named technical associate for the research and development department of Sun Oil Co., Marcus Hook, Pa. Clayden, an SAE member since 1910, will serve as a staff assistant on problems dealing with automotive matters.

Born in England, Clayden has been a Sun engineer for 30 years.

JOHN G. MOXEY, JR., will succeed Clayden as manager of the department's automotive laboratory. He was previously assistant manager of the laboratory. Clayden was SAE vice-president representing fuels and lubricants activity in 1934; Moxey was vice-president representing the same activity in 1952.

PAUL B. BEST, JR., has joined Hupp Corp. as general sales manager. Best will make his headquarters at Hupp's Detroit plant. He was previously vice-president in charge of series motor sales for the Redmond Co., Owosso, Mich.

R. D. JACOBS II has been named to head sales and engineering activities of the new industrial and marine engine division of Reo Motors, Inc., Lansing, Mich. Jacobs joined Reo in 1951 to assist in the preliminary groundwork for the division. He was previously an adviser for GMC's Detroit Diesel Engine Division on marine installations.

REUBEN E. FIELDER has retired from the coach sales department of GMC Truck and Coach Division, Pontiac, Mich. For the past 17 years, Fielder has been Canadian representative for the company. A graduate of the Polytechnical College, London, he entered the transportation industry with the Fifth Avenue Coach Co. in New York and became chief engineer of maintenance and construction before joining the Yellow Truck and Coach Co. in 1925. Fielder will continue to make his home in Grosse Pointe, Mich., and plans work as a bus transportation and financial consultant.

JOHN WALDHERR, JR., has been named director of engineering of Airtex Products, Inc., Fairfield, Ill., which was formerly Chefford Master Mfg. Co. Waldherr was previously chief design engineer for the company.

WILLIAM E. RICE has joined Clark Equipment Co., Buchanan, Mich., as automotive products engineer. Rice was previously with GMC's Truck and Coach Division, Pontiac, Mich., as senior project and design engineer.

C. J. REESE, president and general manager of Continental Motors Corp., was speaker at the recent "management night" of the Michigan Section of the American Society for Quality Control held in Detroit.

J. E. HACKER has been promoted to works manager at GMC's Electro-Motive Division, LaGrange, Ill. He had previously been assistant works manager since coming to the division from Cleveland Diesel Engine Division in 1948. Hacker was SAE vice-president representing production engineering in 1944, and is a past chairman of Cleveland Section.

ARTHUR E. STONE of Solar Aircraft Co., San Diego, Calif., is now on military leave of absence to serve with the U. S. Army.

TAO-WEN MA is now associated with the Bridgeport Thermostat Co., Bridgeport, Conn. He was previously engineer for Wolverine Motor Works in Bridgeport.

Tore Franzen (left) was honored by his Chrysler associates at a banquet in his honor when he retired as staff engineer of Chrysler, after 25 years with the corporation. Vice-President James C. Zeder (right) extends best wishes from the group

TORE FRANZEN has retired as staff engineer of Chrysler Corp. and is now engineering representative of the Burton Auto Spring Corp. of Chicago, Ill. He will continue to live in Grosse Pointe, Mich.

Franzen came to Chrysler in 1928 after having served as assistant chief engineer of Detroit Steel Products Co. A native of Sweden, he came to the United States in 1912. During the last war, he served with the Army Ordnance in Europe.

He has given several papers before the Society on spring suspension and allied subjects. He was chairman of Detroit Section in 1941 and 1942, and is now chairman of the Spring Committee of the Technical Board.

CHARLES L. GAGE is now a project engineer for Weber Aircraft Corp., Burbank, Calif. Gage was formerly with Hughes Aircraft Co., Culver City, Calif., as mechanical engineer and designer.

PAUL R. CHURAN is now automotive engineer for the U. S. Post Office in Washington, D. C. Churan's duties involve consulting on plans and specifications for new wheeled vehicles and conducting research to determine vehicle types and designs best adapted to the postal services. He was previously automotive design engineer at Detroit Tank Arsenal, Detroit, and before that was with General Motors Corp. for 12 years.

WILLIAM R. CUBBINS has been promoted to assistant manager of the national and fleet sales division of Mack Motor Truck Corp., New York City. Cubbins was previously national account sales representative for the company.

WILLIAM C. SPOUSE is now sales engineer for Purves Ritchie, Ltd., Vancouver, B. C. Spouse was previously mechanical superintendent of the British Columbia Forest Service.

CLAY P. BEDFORD, president and director of Chase Aircraft Co., Inc., has been elected a trustee of Rensselaer Polytechnic Institute. Bedford, a 1925 graduate of R.P.I., has been with Chase Aircraft since last May, when he completed a year's work in Washington as special assistant to the Director of Defense Mobilization and the Secretary of Defense. Before that he was executive vice-president and director of the Kaiser-Frazer Corp.

T. RUSSELL MOYLE has joined the Paxton Engineering Co., Los Angeles, Calif., as senior design engineer on chassis components. Moyle was previously a design engineer for Harley-Davidson Motor Co., Milwaukee, Wis.

LOVELL SHOCKEY has been named president of the Dunham Co., Berea, Ohio. Shockey was previously chief engineer of the White Sewing Machine Corp., Cleveland.

FRANK S. BRYAN, associate fuels and lubricants engineer for Standard Oil Co. of California, has been transferred from the company's offices in Pasco, Wash., to Boise, Idaho.

RALPH J. SHIELDS is now service manager of Cummins Diesel Sales of British Columbia, Ltd., Vancouver. Shields was formerly regional service representative for Cummins Engine Co. in Columbus, Ind.

Esso Laboratories Appointments

Tongberg

Fleming

Duncan

Pennekamp

Tobias

DR. CARL O. TONGBERG has been named director of the research division of the Esso Laboratories of Standard Oil Development Co., Linden, N. J. **DR. CHARLES L. FLEMING, JR.**, formerly assistant director, succeeds Tongberg as associate director, and **GORDON W. DUNCAN** moves up from research engineer to assistant director.

ELFRIED F. H. PENNEKAMP was named to head the additives section of the research division. He was previously reearch group leader. **GEORGE S. TOBIAS**, formerly research engineer, assumes new responsibilities as aviation contact representative.

S. D. DEN UYL, president of Bohn Aluminum and Brass Corp., Detroit, was elected a vice-president of the Aluminum Association for 1953 at the association's annual meeting held in New York Jan. 20-22, and **R. A. BLANCHARD**, sales manager of Detroit Gasket and Mfg. Co., was elected a director-at-large for a three-year term.

HUGH W. MacDONALD is now with Stevens Institute of Technology, Hoboken, N. J., as deputy director of the experimental towing tank.

HJALMAR STROM has retired as technical sales manager of oy Esso ab, Helsinki, Finland. He will continue to run his own technical book publishing company.

H. W. TOOMEY, Latin American Division manager for Pan American World Airways, has moved his headquarters from Miami to Rio de Janeiro.

LEWIS E. WILLIAMS is now a sales engineer for Huppert Equipment Co., Waukesha, Wis. He was previously sales engineer for Waukesha Motor Co.

FRED C. HEINIG has been named chief field service representative for the newly-established gas turbine field service unit of Solar Aircraft Co., San Diego, Calif. Heinig was previously project engineer for Solar.

T. L. ROBINSON, who was formerly president of the Wel-Met Co., Kent, Ohio, is now president of Powdercraft Corp., Spartanburg, S. C.

LeGRAND H. LULL is now a director of the Baker-Lull Corp., Minneapolis, Minn. Lull was previously president of the newly-acquired subsidiary of the Baker-Raulang Co., which was formerly called Lull Mfg. Corp.

Secretary of Defense **CHARLES E. WILSON** received the 1952 George Washington Carver Memorial Institute Gold Award on Jan. 19 for his "outstanding contributions to the betterment of race relations and human welfare." Wilson was selected to receive the award not only for his personal activities, but for his policies as president of General Motors, the post he recently left to join the cabinet of President Eisenhower.

JOHN SASSO has been elected vice-president of G. M. Basford Co. advertising agency. He joined the company in 1952 and is responsible for the direction of industrial publicity and technical literature.

ARTHUR H. KIBIGER has joined Chrysler Corp., Detroit, to head the corporation's new advanced styling studio. Kibiger was formerly director of styling for Willys-Overland Motors, Inc., Toledo, Ohio, for more than six years, and was assistant director of styling for Hudson for 12 years before that.

CARL E. SCHMITZ has been named vice-president in charge of sales of the Crane Packing Co., Chicago, Ill. Schmitz' former title was vice-president and director of engineering. He has been with Crane since 1942.

DR. ARTHUR A. BROWN has been appointed vice-president of Bowser Technical Refrigeration, Terryville, Conn. Prior to joining Bowser, Brown was with Pratt and Whitney Aircraft for 12 years, serving as test engineer, assistant project engineer, and chief installation laboratory engineer. During 1951-52, he was chairman of the subcommittee on icing problems of the NACA.

ROBERT G. LYON has been named account executive for Ross Roy, Inc., Detroit. He was previously technical director for the firm, which he joined in 1948.

DR. JOHN W. ENELL, assistant professor of industrial engineering at New York University, recently returned from a three-month government mission to Europe. Sponsored by the U. S. Mutual Security Agency, he served as management adviser to 20 manufacturers in the Italian electrical industry, giving aid particularly on problems of quality control.

ALLAN C. LEWIS has been named assistant chief inspector of the car building division of Chrysler Corp., Detroit. He was previously on special assignment for Chrysler's inspection division at Kercheval plant.

E. J. CLOUTIER, JR., who was previously district manager of the Pacific Coast sales office of Tinnerman Products, Inc., in Los Angeles, has been transferred to Tinnerman's Detroit office.

FRANK J. BERTO has joined the Lago Oil and Transport Co. on Aruba, Netherlands West Indies, as junior mechanical engineer. Berto was previously with the Vancouver Engineering Works in Vancouver, B. C., and has been serving as publicity chairman of SAE's British Columbia Section.

P. R. MacIVER is now commander of the electrical and mechanical engineers of the 1st Division of the Arab Legion, Jordan. He was previously lieutenant commander at 1st Division headquarters.

HARVEY S. KING has been promoted to inspection foreman, supervising inspection personnel in the utility shop of Republic Aviation Corp., Farmingdale, N. Y. King was previously principal inspector.

HAROLD C. BALDWIN is now a manufacturers agent in Ponca City, Okla. He was previously engineering representative for Continental Oil Co. in Ponca City. Baldwin is vice-chairman of SAE's Mid-Continent Section.

HENRY K. LANZ is now a mechanical research engineer with the wind tunnel section of the research department of United Aircraft Corp., East Hartford, Conn. Lanz was formerly with Bell Aircraft's helicopter division, Buffalo, N. Y., as test engineer.

PETER KULKA has been transferred to the J-47 jet engine project of General Electric Co. in Cincinnati, Ohio. Kulka was previously field service engineer with the ALCO-GE Division in Syracuse, N. Y.

WALTER O. KOEHLER is now national accounts representative for the Studebaker Corp. in Philadelphia, Pa. He was previously with Atlantic Greyhound Corp., Richmond, Va., as maintenance statistician.

KAZIMIERZ T. KSIESKI is now chief research engineer of Aero Supply Mfg. Co., Inc., Corry, Pa. Ksieski was previously project engineer for A. V. Roe Canada, Ltd., in Toronto, Ont.

Four SAE members were elected vice-presidents of the Manufacturers Aircraft Association at the Association's recent annual meeting in New York City. They are **ROBERT E. GROSS**, of Lockheed Aircraft Corp., **CHARLES H. CHATFIELD** of United Aircraft Corp., **J. H. KINDELBERGER** of North American Aviation, and **JOHN A. SANBORN**, general manager of the Manufacturers Aircraft Association.

DR. CARL B. POST, chief metallurgist of the Carpenter Steel Co., Reading, Pa., has been awarded the Bradley Stoughton plaque for outstanding work in metallurgy by the Lehigh Valley Section of the American Society for Metals, Bethlehem, Pa.

WILLIAM R. CUBBINS, JR., is now assistant manager for the national and fleet sales division of Mack Motor Truck Corp., with headquarters in New York City. Cubbins was previously national account representative for Mack, and prior to that was assistant to the president of the Flight Training Research Association in Washington, D. C.

CHARLES B. HANSSEN has joined Chrysler Institute of Engineering, Highland Park, Mich. Hanssen was previously mechanical engineering research assistant at the Army's Engineering School at Fort Belvoir, Va.

William Stout Interviewed . . .

On a recent flying visit to Detroit, SAE Past President **WILLIAM B. STOUT** was cornered by Detroit News Reporter Robert S. Ball, who wrote the following interview:

"William Bushnell Stout is of the opinion that the dragonfly has a more promising future in the development of aviation than the City of Detroit.

"The pioneer Detroit aeronautical engineer, now in semi-retirement in Phoenix, Ariz., reached this conclusion some years ago, and confirmed it Thursday night in a rare visit here.

"For more than a quarter century, Bill Stout has maintained that insects, notably the dragonfly, offer the most stirring challenge to those who would achieve perfection in man-made flight.

Wind Tunnel Tests

"Devoting most of his time to proving this theory during the past four years, Stout is now conducting wind tunnel tests on mechanical reproduction of insect flight in his Phoenix laboratory.

"Actual full-scale flights are not too far away, he hinted.

"Stout, who is 72, conferred with the Michigan Aviation Historical Committee, now engaged in preparing a history of the state's role in aeronautical achievement.

"He spoke at the Rackham Educational Memorial but, in a typically Stout performance, dwelt only briefly on the past and devoted most of his talk to what lies ahead.

"He fears that highway and city street congestion will become so great in the not too distant future that the only solution lies in giving vehicles 'airability.'

Has a Solution

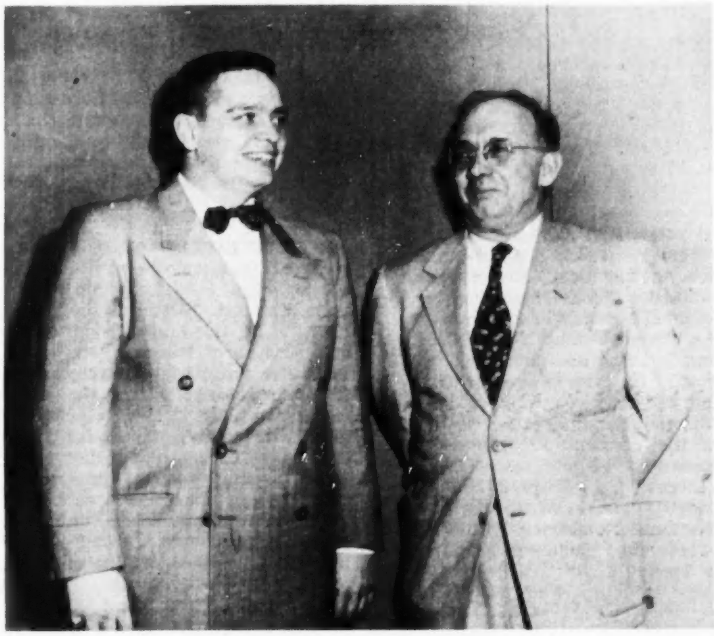
"Stout has been forecasting this for a long time. Events of the past decade now support his belief.

"He thinks he has the solution in his development of the 'geflopigator,' which is Stout language for his imitation of insect flight.

"His latest models are flapping at speeds comparable to those of a dragonfly wing, and producing amazing thrust and lift forces.

"Stout has reached the conclusion that the most efficient flying machine of the future will be patterned after a tandem dragonfly, sporting four wings on each side, although a sport model might have only two.

"California Institute of Technology is carrying on some of his research projects, and his greatest ambition is to get the younger generation interested in his project."



SAE Father and Son

WILLIAM A. BARNES (J '50) and **WILLIAM B. BARNES** (M '20). The elder Barnes is the owner of Barnes Motor Developments Co. and his son is his engineering associate. They live and work in Muncie, Ind.

SAE Members Are Saying . . .

"In the last 10 years, Government payments for research have increased from 35 to 56%. If this rate of increase should continue, soon private industry may be squeezed out of research, either because Government has a monopoly on the talent, or because the discoveries have been socialized." . . . **John L. Collyer**, president, The B. F. Goodrich Co., at the 45th Annual Convention of the American Institute of Chemical Engineers.

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"In our interest in new materials, we sometimes forget what a wonderful material steel is. If we were all using plastic or aluminum bodies today, and someone came along with a new idea—steel—we'd all say: 'My, what a wonderful discovery, this new metal!' " . . . **James C. Zeder**, vice-president and director of engineering and research, Chrysler Corp., at the Public Affairs Forum of the Tulsa Chamber of Commerce.

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"I am convinced that in the shorter ranges the favorable characteristics of the turboprop, geared to the airport problem much more than to speed, indicate that it is the logical eventual answer for such aircraft. In the very long ranges where fuel consumption becomes the most critical factor, and you run out of weight, the turboprop with its much better fuel economy again becomes the more appealing type. But there seems to be a bracket of ranges, between those two limits, in which the turbojet will do a very economical and efficient high performance job." . . . **William Littlewood**, vice-president—engineering, American Airlines, in an interview in American Aviation.

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"The Society (SAE) has, in its general make-up, an astonishing ability to disregard competitive secrecy and make fully available to all concerned the best and latest thinking of each product manufacturer." . . . SAE President **Robert Cass**, at a meeting of the Private Council of Motor Truck Owners.

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"One young RAF fighter pilot took off from Prestwick after a plane, which, in the murky atmosphere, resembled a Focke-Wulfe bomber. He fired 600 rounds of ammunition as he buzzed around TWA's C-54, trying to bring her down or scare her off. He later was courtmartialed, the story goes, not for firing at the plane, but because he had used the precious 600 rounds of ammunition without once hitting the target!" . . . **Ralph S. Damon**, president, Trans World Airlines, at National Newcomen Dinner of the Newcomen Society of England, New York.

PAUL E. TOBIN has been put in charge of a new North Atlantic region of White Motor Co. Tobin was previously manager of the Metropolitan New York region. The new territory will include New England and upper New York.

JOHN V. MOFFITT, who was previously chief engineer of Ackerly Marine, East Rockaway, N. Y., has joined the Southwest Research Institute, San Antonio, Texas, as project engineer.

L. IRVING WOOLSON, president of DeSoto Division of Chrysler Corp., was among the speakers at the banquet celebrating the completion of the first semester of Wayne University's new Materials Management Center.

H. H. WAKELAND is now research associate at the Engineering Experiment Station at Purdue University, Lafayette, Ind. Wakeland was formerly assistant development engineer for Nash Motors Division of Nash-Kelvinator Corp., Kenosha, Wis.

ALEXANDER H. BEN-AZUL is now with the foreign operations and sales department of Corporacion de Fomento of Chile. He was previously with the manufacturing engineering office of Ford Motor Co., Dearborn, Mich.

MAXWELL W. CLINE is now president and general manager of Cline Truck Co., Kansas City, Mo. Cline was formerly vice-president of Sinclair Coal Co., and prior to that was president and general manager of the Dart Truck Co., both in Kansas City.

ROSS G. WILCOX is now with the Highways and Municipal Bureau of the Portland Cement Association, Chicago, Ill. Wilcox was formerly assistant director of the traffic and transportation division of the National Safety Council in Chicago.

JOSEPH LISTON, professor of aeronautical engineering at Purdue, is the author of a recently published textbook entitled "Powerplants for Aircraft." Included are: comprehensive comparisons of the many types of jet and reciprocating powerplants, a fundamental analysis of the theoretical powerplant cycles, a comparison of actual engine performance with the theoretical cycles, and a discussion of some of the practical problems encountered in operation and testing.

The author emphasizes fundamental principles, and uses a broad approach, involving the consideration of all types of aircraft powerplants. He makes full use of diagrams and illustrations to round out the discussions. Publisher is McGraw-Hill, New York City. Price is $8.50.

STUDENTS ENTER INDUSTRY

ELWIN R. HENNEBERG (San Diego State College '52) is with the guided missile division of Consolidated Vultee Aircraft Corp., San Diego, Calif.

JOFFRE P. MYERS (University of Idaho '52) is a mechanical engineer for Sandia Corp, Albuquerque, N. M.

ERNESTO J. WEBER (California Institute of Technology '52) is now in Mexico as sales engineer for Proveedores Tecnicos.

STANLEY I. STEIN (Northrop Aeronautical Institute '52) is a servomechanisms engineer for Bell Aircraft Corp., Niagara Falls, N. Y.

KENNETH SOUTHALL (University of Connecticut '52) is a design engineer in the mechanical development laboratory of E. I. duPont de Nemours and Co., Wilmington, Del.

PHILIPP A. LEISINGER (Purdue University '52) is a sales engineer for the Aluminum Co. of America, Pittsburgh, Pa.

RICHARD C. MEYER (University of Wisconsin '52) has joined Hamilton Standard Propeller Division of United Aircraft Corp., Windsor Locks, Conn.

DAVID VIAL (University of Illinois '52) is in training with International Harvester Co., Chicago.

WILLIS J. SPICER (Rensselaer Polytechnic Institute '52) has joined the Arabian American Oil Co. in Dhahran, Saudi Arabia.

ALLEN E. CABLE (Yale University '52) is now a process engineer for Singer Mfg. Co., Bridgeport, Conn.

SOHAN SINGH JIAN (Indiana Technical College '52) is a die designer for Union Die Casting Co., Ltd., Los Angeles, Calif.

NESTOR JARAMILLO, JR. (Oklahoma A & M College '52) is now in Bogota, Colombia, as petroleum engineer for the Texas Petroleum Co.

DAVID L. HILLIS (Yale University '52) has joined the Carbide and Carbon Chemicals Corp., Oak Ridge, Tenn., as a reactor student at the Oak Ridge National Laboratory.

ROBERT P. MAXFIELD (A & M College of Texas '52) is a second lieutenant in the U. S. Army.

DONALD B. EPNER (Academy of Aeronautics '52) is now with North American Aviation, Inc., Los Angeles, Calif., as a flight line mechanic.

EDWARD YARKOSKY (Parks College '52) is an experimental flight test engineer for Boeing Airplane Co., Wichita, Kans.

FRANK HAYWARD (West Coast University '52) is with Hoffman Laboratories, Los Angeles, as mechanical engineer.

PAUL H. SCHMITT (University of Wisconsin '52) is a laboratory assistant for A. O. Smith Corp., Milwaukee, Wis.

ROBERT A. RAMSER (Ohio State University '52) has joined the Aluminum Co. of America, New Kensington, Pa., as research engineer.

JOHN J. STEUBY (Illinois Institute of Technology '52) is in training with Caterpillar Tractor Co., Peoria, Ill.

JOSEPH NUZZO (Cal-Aero Technical Institute '51) is a liaison engineer for Grand Central Aircraft Co., Glendale, Calif.

ELDON W. TIBBITS (Michigan State College '52) is with the engineering division of Reo Motors, Inc., Lansing, Mich.

ROBERT HEIDE (Bradley University '52) is now with the State of Illinois Division of Highways.

JOHN C. SINGHURSE (Parks College '52) is a second lieutenant in the U. S. Air Force.

ALBERT E. FISCHER (Fenn College '52) has joined the powerplant unit of Boeing Airplane Co., Seattle, Wash.

EDWIN C. YOUNGHOUSE (Cornell University '49; Chrysler Institute '51) is a research engineer for Standard Oil Development Co.'s research division in Linden, N. J.

PAUL L. WYZENBEEK (Rensselaer Polytechnic Institute '52) is with Procter and Gamble Mfg. Co., Staten Island, N. Y., as project engineer.

Obituaries

DANIEL GURNEY

Daniel Gurney, vice-president and director of engineering of the Marlin-Rockwell Corp., Jamestown, N. Y., died Feb. 3 at the age of 52. He had been ill for some time.

Gurney was born in Yankton, S. D., but at the age of two came to Jamestown, where his father founded the Gurney Ball Bearing Co., forerunner of the Marlin-Rockwell Corp.

Gurney joined Marlin-Rockwell in 1923 after graduating from Oberlin College and doing graduate work in electrical engineering at Massachusetts Institute of Technology. In 1929 he moved to New York City for research work in sound movies at the Bell Telephone Laboratories, and was later associated with Technical Motion Pictures and the Landis Tool Co., Waynesboro, Pa. He rejoined Marlin-Rockwell in 1938.

He was active on several panels and committees of the Coordinating Research Council, the Anti-Friction Bearing Manufacturing Association, the American Society of Tool Engineers, and SAE. He was also a member of Jamestown's Board of Public Utilities, the Chamber of Commerce, and the University Club.

Gurney is survived by his wife, a son and daughter, and two grandchildren.

SAMUEL KOFFSKY

Samuel Koffsky, chief engineer of Simmons Machine Tool Corp., Albany, for the past 16 years, died suddenly on Jan. 15. He was 50.

During World War II Koffsky designed a 36-foot circular boring mill for machining the forged steel turret on which the large guns of a battleship swivel, eliminating a major bottleneck in the production of turrets.

Koffsky, a 1923 graduate of Rensselaer Polytechnic Institute, joined the New York State Department of Public Works after graduation, and was later with William Russell Davis, consulting bridge engineer, helping to design the Peace Bridge over the Niagara River and many others. Before joining Simmons in 1936, Koffsky was a consulting engineer in Albany.

He was a member of the American Society of Civil Engineers and ASME as well as of SAE.

TECHNICAL COMMITTEE *Progress*

New Service Classification Adopted for Oil Designation

A NEW system of service classification and designation for crankcase oils, recently adopted by the American Petroleum Institute, has been approved for publication in the 1953 SAE Handbook together with explanatory information provided by the SAE Fuels and Lubricants Technical Committee.

In place of the now obsolete API oil classifications—regular, premium, and heavy duty—have emerged five service classifications. Three are for gasoline engines; two are for diesel units. But all five take into consideration all of the service variables that may have an effect on crankcase oils—vehicle operating conditions, engine design, and fuel type. Here are the service classifications, as defined by API, together with abridged explanations of what they cover:

Service MS—Service typical of gasoline or other spark ignition engines operating under unfavorable or severe types of service conditions, and where there are special lubrication requirements for deposit or bearing corrosion control, due to operating conditions or to fuel or to engine design characteristics.

Service MS normally represents the most severe service conditions encountered in the operation of gasoline and other spark ignition engines. It includes both start and stop service and high-temperature, high-speed service.

Service MM—Service typical of gasoline and other spark ignition engines operating under moderate to severe service conditions, but presenting problems of deposit or bearing corrosion control when crankcase oil temperatures are high.

This is a more moderate service condition than service MS. Included in this classification are vehicles powered by engines relatively insensitive to deposit formation when operated at high speeds and under heavy loads with fuels of suitable characteristics.

Service ML—Service typical of gasoline and other spark ignition engines operating under light and favorable service conditions, the engines having no special lubrication requirements and having no design characteristics sensitive to deposit formation.

This is the least severe service condition for gasoline engines. It includes practically continuous operation at moderate speeds, with no severely low or high engine temperature operation. It also covers operation of vehicles with engines that are insensitive to sludge, deposit formation, and fuel characteristics.

Service DG—Service typical of diesel engines in any operation where there are no exceptionally severe requirements for wear or deposit control due to fuel or to engine design characteristics.

Rated load, continuous output or intermittent operation under normal temperature conditions are considered normal service requirements for service DG. Depending upon individual engine design, most diesel engine builders have designated maximum fuel sulfur limits for this service classification.

Service DS—Service typical of diesel engines operating under extremely severe conditions or having design characteristics or using fuel tending

Table 1—Comparison of Crankcase Oil Classification Systems

New API Service Classifications	Classifications Generally Recognized as Defining Oils Suitable for Use Under Former Systems	Designation Under Previous System of API Nomenclature or Definitions for Crankcase Oils
For Service ML	Regular	Regular Type "generally suitable for use in internal-combustion engines under moderate operating conditions."
For Service MM	Premium	Premium Type "having the oxidation stability and bearing corrosion preventive properties necesary to make it generally suitable for use in internal-combustion engines where operating conditions are more severe than Regular Duty."
For Service MS	2-104B, or MIL-0-2104, or Supplement 1	Heavy-Duty Type "having the oxidation stability, bearing corrosion preventive properties, and detergent dispersant characteristics necessary to make it generally suitable for use in both high-speed diesel and gasoline engines under heavy-duty service conditions."
For Service DG	MIL-0-2104, or Supplement 1	
For Service DS	Supplement 2	

to produce abnormal wear or deposits.

The service conditions in this classification are the most severe encountered in the operation of diesel engines. High load operation at high temperatures, intermittent operation at low temperatures, and design factors or engine installation details that cause high temperatures within the engine all fall in this category. Use of high sulfur content fuels also frequently constitutes severe service.

Dual Service Oils Possible

Actually, however, nothing prohibits the use of an oil for more than one service, provided it is suitable for each. In such instances, the designation should indicate both services, for example, "For Services MS-DG." (This would denote an oil satisfactory for both severe gasoline engine and normal diesel engine conditions.) Similarly, if automotive engineers wish to recommend an oil for especially severe gasoline engine service, they may make recommendations in terms of oils developed for service in diesel engines.

What's more, in cases where the new system may not meet some special recommendation requirements, there remains the possibility of making recommendations by various crankcase oil specifications or by use of approved lists. In general, these cases should become rare as the new service classification system becomes more generally understood by the oil and automotive industries and the general public.

As an educational guide to prospective users, the report includes the tabulation shown in Table 1. This table indicates in a general manner how oils classified by oil designation systems could be recommended for use under the service classification system.

Two Standards From TPHLF Committee

TWO standards developed by the SAE Tube, Pipe, Hose, and Lubrication Fittings Committee were recently approved by the SAE Technical Board:

1. Automotive and General Service Copper Tubing.
2. Flareless Fittings.

Copper Tubing

The copper tubing specification, which has also been approved by the SAE Nonferrous Metals Committee, covers minimum requirements for seamless annealed copper tubing manufactured for automotive and general service purposes. It includes eight

Among reports recently approved by the SAE Technical Board are . . .

5 NEW CARBON STEELS—To the SAE Standard on Chemical Compositions of SAE Carbon Steels have been added five new steels. Composition limits on four plain carbon steels as specified for semifinished products for forging, hot-rolled and cold-finished bars, wire rods, and seamless tubing are:

SAE Grade	C, %	Mn, %	P, %	S, %
1012	0.10/0.15	0.30/0.60	0.040	0.050
1023	0.20/0.25	0.30/0.60	0.040	0.050
1037	0.32/0.38	0.70/1.00	0.040	0.050
1084	0.80/0.93	0.60/0.90	0.040	0.050

Carbon limits for structural shapes, plates, strip, sheets, and welded tubing will be two points wider.

The fifth new steel on the SAE list is SAE 1108, for which carbon is specified at 0.08 to 0.13%; manganese at 0.50 to 0.80%; phosphorus at 0.040%; and sulfur at 0.050%.

ANTI-FRICTION BEARINGS—Several tables in the SAE Standard on Ball and Roller Bearings have been consolidated so that bearings of similar boundary dimensions appear together. Also some new sizes have been added to the SAE Standard on Taper Roller Bearings. The changes were worked out by the SAE Ball and Roller Bearings Committee.

USAF Commercial Vehicle Maintenance

USAF GROUND VEHICLE MAINTENANCE—With a huge fleet of commercial vehicles under its wing, the U. S. Air Force is naturally maintenance conscious. Right now, in fact, it has a plan underway to set up efficient pilot maintenance and repair shops that will take advantage of good commercial practice. That's why this exploratory group of fleet operators and USAF representatives got together at SAE headquarters on Jan 22—to study possible ways that SAE might be of service to the USAF in setting up these model shops.

After hearing what the USAF had in mind, SAE members in this exploratory group felt it desirable to review a break-down of USAF vehicles and maintenance manuals. Also, it was felt desirable to visit a typical Air Force base installation.

When this has been done, this exploratory group will outline any and all possible ways that SAE can help the USAF, then recommend this program to the SAE T&M Technical Committee.

standard sizes ranging from ⅛- to ¾-in. outside diameter. It covers temper, chemical composition, tensile properties, workmanship and finish, dimensions, and tolerances. It also contains data on making an expansion test and a pressure proof test.

This standard provides a basis for both acceptance and performance data for copper tube used in the automotive industry. It does not replace SAE 75 for copper tubes, which is a broad specification intended to cover a wide diversity of products.

Flareless Fittings

The standard for hydraulic tube fittings of the flareless type covers the following items: types and styles, dimensions and tolerances, passages, wall thickness, straight threads, pipe threads, material, workmanship, and finish. Because the standard is new and because it is of extreme importance that the fittings be properly assembled, detailed assembly and reassembly instructions are being included until experience with this type of fitting becomes general.

This standard is also of interest to the military.

Transmission, Axle Lubes Have Changes

SAE's Fuels and Lubricants Technical Committee has altered the system for classifying transmission and axle lubricants. The revisions, which will be included in the 1953 SAE Handbook, are as follows:

- The first sentence in paragraph one has been changed to read, "The SAE viscosity numbers for transmission and axle lubricants constitute a classification in terms of viscosity only."
- The column of temperature values in Table 1 headed, "Consistency—Must Not Channel in Service at" has been removed.
- The next to last paragraph has been replaced with these two paragraphs:

"The maximum viscosity limit for SAE 250 is not specified, since this grade is a special one for temperatures at which SAE 140 is too light. This lubricant shall have sufficiently low maximum viscosity for the service for which it is recommended.

"The lubricant supplier is responsible for providing, for each of the viscosity grade products listed in Table 1, satisfactory non-channeling characteristics at the lowest temperatures for which it is recommended."

Need for High Quality In Brake Fluids Reiterated

THE SAE Standard on non-mineral oil brake fluids describes the **minimum** properties for safe operation, it has been emphasized in recent meetings of the Nonmetallic Materials Committee and its Subcommittee on Hydraulic-Brake Fluids.

Every requirement in the SAE Standard on Hydraulic-Brake Fluid (SAE 70R) is there because it is vital to dependable braking, says Hydraulic-Brake Fluids Subcommittee Chairman Markey. Table 1 shows the current requirements as outlined in the Standard as well as his ideas of the characteristics of an ideal fluid. He offered the comparison at the January 12 meeting of the Nonmetallic Materials Committee during a discussion of the reasons behind brake fluid requirements. The table is taken from a paper Markey presented before the Chemical Specialty Manufacturers Association, a paper which has been circulated to the Nonmetallic Materials Committee.

Minimum boiling point—one of the most important requirements in the SAE Standard— is called out to insure that brake fluid will remain in the liquid, incompressible state. The danger of fluids with low boiling points is that heat from the engine will vaporize brake fluid in the main brake cylinder and send the vapor into the lines. With vapor in the lines, brake pedal movement merely compresses the vapor instead of applying hydraulic pressure to force brake shoes against linings. Brake failure due thus to vapor lock is particularly insidious because it comes without warning.

The SAE Standard outlines a special method of determining boiling point, different from the very sensitive ASTM first-drop-over-distillation method. Reason is, according to Markey, that an amount of volatile materials too small to spoil brake action might be enough to give a low ASTM boiling point. Boiling points of brake fluids obtained by the SAE method closely approximate the temperatures at which the fluids will boil in the brake system of a car with no static check valve pressure. Normal residual line pressure in the brake system is 8-15 psi, which raises the boiling point of the fluid around 15-35 F.

Review of reasons behind other requirements in the SAE standard have brought out at recent SAE technical committee meetings that:

Viscosities—Maximum viscosity is specified as 1800 cs at -40 F to insure that brake action will be reasonably fast and even at low temperatures. Minimum viscosity is specified as 3.5 cs at 130 F to lessen chance of leakage at high temperatures. Manufacturers who load up their brake fluids with diluents because diluents are cheap and disregard high-temperature viscosity of the mixture risk blame for brake failures under hot-weather conditions in brake systems which are not perfectly sealed.

Freezing Point—The cold tests give evidence of whether or not a fluid will solidify or separate after prolonged exposure in low temperatures.

Flash Point—Considerations not of performance but of safety in handling, transporting, and storing necessitate setting of a minimum flash point. (The ideal fluid would, of course, be nonflammable.)

Water Tolerance—Since small quantities of water sometimes find their way into passages in brake systems, the SAE Standard provides that 100 cc of brake fluid mixed with 3½ cc of water shall show no precipitation or stratification after 24 hr at 140 F and none after 24 hr at -40 F. If the water and brake fluid remain emulsified throughout these periods, it is taken as an indication that the water will not separate out in service, form ice, and block passages that must be open for brakes to act.

Other requirements in SAE 70R are there to insure that brake fluids will not attack the materials with which they come in contact, and that replacement fluids will be compatible with original-equipment fluids.

It may be necessary someday to specify lubricating qualities as well as the other properties of brake fluids so that they will be adequate for hydraulic power brakes, power steering units, and window lift devices.

SAE Journal Index Available

A complete Index covering the twelve 1952 issues (Vol. 60) of the SAE Journal is now available to members and subscribers free upon request.

Table 1—Comparison of Certain Requirements for SAE 70R1 and SAE 70R2 Brake Fluids and an "Ideal" Brake Fluid

Requirements	SAE 70R1 Heavy-Duty Brake Fluid	SAE 70R2 Moderate-Duty Brake Fluid	"Ideal" Fluid
Viscosity (kinematic) at -40 F, max	1800 centistokes	1800 centistokes	500 centistokes
Viscosity (kinematic) at 130 F, min	4.0 centistokes	3.5 centistokes	20 centistokes
Cold test (6 days at -40 F)	Shall begin to flow within 5 sec after the sample bottle is tilted from the vertical to horizontal position. No stratification or precipitation.	Shall begin to flow within 5 sec after the sample bottle is tilted from the vertical to horizontal position. No stratification or precipitation.	——
Freezing point (6 hr at -60 F)	Shall begin to flow within 5 sec after the bottle is tilted from the vertical to horizontal position.	——	Flow immediately. No stratification. No precipitation.
Boiling point, F, min	300	230	500
Flash point, F, min	145	100	Nonflammable
Water tolerance	100 cc of fluid mixed with 3.5 cc of water, at 140 F and -40 F, shall begin to flow within 5 sec after the sample bottle is tilted from the vertical to horizontal position. No stratification or precipitation.	100 cc of fluid mixed with 3.5 cc of water, at 130 F and -40 F, shall begin to flow within 5 sec after the sample bottle is tilted from the vertical to horizontal position. No stratification. Slight precipitation permitted.	100 cc of fluid mixed with 10.0 cc water, at 200 and -60 F, shall flow immediately. No stratification.
Neutrality	pH 7 to 11	pH 7 to 11	pH 7 to 8
Neutrality after corrosion test	pH 6 to 11	pH 6 to 11	pH 7 to 8
Stability, min boiling point, F			
Odor	——	——	Odorless
Attack on lacquer and enamel	——	——	No attack
Foaming	——	——	Very little
Color	——	——	Distinctive

CRC Releases Five Reports

THE following Coordinating Research Council reports have been released for distribution and are available from SAE Special Publications Department, 29 West 39th Street, New York 18, N. Y. (This is a complete list of CRC reports released since publication of the listing of CRC reports on page 74 of the March, 1952 SAE Journal.)

Diesel Fuels

CRC-263—Combustion Characteristics—Ignition Delay Bomb, 1948-1950 (9/51) Price: $1.50 to SAE members; $3.00 to nonmembers

CRC-265—Effect of Variation of Internal Atmosphere Upon Evaporation and Combustion of Fuels in a Constant Volume Bomb (2/51) Price: $1.00 to SAE members; $2.00 to nonmembers

Motor Fuels

Detonation—Full-Scale

CRC-262—Octane Number Requirement Survey—Commercial Vehicles, 1950 (3/51) Price: $1.00 to SAE members; $2.00 to nonmembers

CRC-264—Analysis of 1950 Road Rating Exchange Data (9/51) Price: $1.00 to SAE members; $2.00 to nonmembers

CRC-266—Octane Number Requirement Survey, 1951 (4/52) Price: $5.00 to SAE members; $10.00 to nonmembers

Why's and Wherefore's of Brake Dynamometers Mapped Out for Users of New SAE Brake Test Code

- **Why are inertia dynamometers used to evaluate vehicle brakes?**
- **What are the important elements of these brake testers?**
- **What kind of instrumentation is necessary?**
- **Just how far can brake dynamometers go in brake evaluation?**

All of these are typical questions that might enter the minds of prospective users of the new SAE Brake Test Code—Dynamometer. And drafters of the Code, SAE Brake Subcommittee 3, were quick to recognize this. But they also realized that including all this supplementary information in the Code would both date it and make it too long. So they did the next best thing. They put together a comprehensive report on the why's and wherefore's of brake testing dynamometers and presented it, under T&B Activity sponsorship, at the 1953 Annual Meeting. Here's part of what they had to say . . .

Why Brake Dynamometers?

The inertia dynamometer is an extremely useful laboratory tool for evaluating brake assemblies, components, and friction materials. With its ability to simulate vehicle kinetic energy, road speed, and in many instances, cooling conditions, it gives brake designers advance notice of what may happen when their creations are put to the acid test.

Admittedly, it can't duplicate all the operating conditions to which brakes will be subjected in service, nor can it eliminate the need for road testing brakes. But it can and does supplement and shorten the amount of road testing necessary. Not only can special studies be made with instrumentation that would be difficult to use in the field, but visual studies can be made of brakes and components in operation—a physical impracticality on road tests. What's more, many modifications can be checked out on a brake dynamometer in the time required to test one such change on a vehicle.

Design Features

Used as a brake testing machine, the inertia dynamometer has these six important components:

1. Foundation
2. Laminated flywheel and supports
3. Brake support
4. Driving mechanism
5. Control and recording instruments
6. Blower or cooling equipment

The foundation provides and maintains accurate alignment of the main pedestal bearings as well as the driving mechanism and brake support. Most foundations consist of a cast metal bed plate set in concrete.

The laminated flywheel generally consists of a master plate, keyed or otherwise fixed to a heavy, rigid shaft. A group of balanced discs may be bolted to the master plate to provide greater rotating mass. The entire shaft and flywheel assembly is supported on trunnion bearings which are self-aligning and of the best antifriction type. The brake drum is mounted on a flange at one end of the main shaft, and the dynamometer driving mechanism normally located at the other end.

The brake support provides a mounting for the brake assembly. It is usually a flanged through-shaft carried on antifriction bearings in a pedestal or tailstock. Either the shaft can be mounted longitudinally to withdraw the brake assembly from the drum or the entire pedestal or tailstock can be moved along the dynamometer base for this purpose. With this construction, the torque arm is attached to the end of the throughshaft opposite to that on which the brake is mounted. The rotative force in the torque arm, which indicates the output of the brake, is measured by various devices, such as hydraulic pistons, strain gages, and platform scales. (See Fig. 1.)

Flywheel driving devices are of two general types. One is a direct-connected electric motor (see Fig. 2); the other is an oil gear type wherein an electric motor drives an oil pump which in turn propels an oil driving unit direct-connected to the flywheel main shaft. These propelling devices vary in size up to 150 hp. High torque capacity with minimum drag on the main shaft after cutoff are prerequisites.

Control and recording instruments differ widely, depending on the type of brake test being conducted. Many tests are time cycle tests wherein a synchronous motor maintains a stop-start brake application cycle through a series of cams and switches. A second type of test places the control of the dynamometer on a temperature basis so that the starting of the cycle is a function of brake temperature.

Control of cooling air to the brake, so that test conditions simulate as closely as possible brake cooling in actual service, has been a difficult problem. Many original dynamometers were built with an exhaust fan as the only means of circulating air

DRAFTERS . . .

. . . of this useful package of information for prospective users of the new SAE Brake Dynamometer Test Code were SAE Brake Subcommittee 3 members:

R. K. Super, Timken-Detroit Axle Co., Chairman
D. J. Bonawit, Marshall-Eclipse Division, Bendix Aviation Corp.
D. P. Dyer, Budd Co.
R. A. Goepfrich, Bendix Products Division, Bendix Aviation Corp.
G. H. Hunt, Motor Wheel Corp.
J. F. Johnson, Raybestos-Manhattan, Inc.
A. E. Kimberly, Chrysler Corp.
G. K. McCann, Ford Motor Co.
E. O. Reynolds, American Brakeblok Co.
W. S. Rigby, Wagner Electric Corp.
E. H. Wells, Jr., Johns-Manville Corp.

over the brake drum. Actually, these were for the purpose of carrying off smoke and dust. More recent dynamometers have both exhaust blowers and pressure fans connecting to a housing over the entire brake assembly.

Instrumentation

Instrumentation is needed to measure brake effectiveness, brake input, brake characteristics, and to control general test conditions.

To evaluate brake effectiveness, a brake test machine must not only simulate service conditions, but it must also measure and control the brake's work. Thus a graphic torque recorder is used to record brake output and to provide a record of the torque required to maintain a certain brake output. The other measure of brake effectiveness—stopping time—is either recorded by a time clock or computed from the time coordinate on the graphic torque recorder.

Brake effectiveness cannot be measured with output values alone. Interdependence of output and input is the most important relationship in evaluation of brake dynamometer work and for that reason, whether measurement is visual or recorded, input values are closely watched throughout tests. Brake input pressure is measured with a graphic recorder and brake speed with an electric tachometer. (Speed control is important both for fade test work and evaluation of a brake's effectiveness at different speeds.)

As for brake characteristics, some can be evaluated with instruments, some can not. A multiple point recording potentiometer with a response speed of 2.5 sec is recommended for measuring brake temperature. While it is not fully correct to call temperature a brake characteristic, it is an important aid in the correlation of field and laboratory data. What's more, recording this variable enables testers to correlate brake behavior with brake temperature.

Measurement of brake and lining wear is an important part of brake dynamometer research, too, but no standard instrument has been accepted for wear measurement during tests. Devices for checking pedal reserve and the like have been incorporated in some dynamometers, but micrometers are still the most universal method for determining wear.

Other characteristics, such as noise and distortion, are not so readily measured. Distortion in the brake elements is measured with strain gages or with dial indicators and a stroboscope. As for noise evaluation, while assorted devices may be used to measure frequency and noise level, the human ear is generally considered satisfactory for brake dynamometer work.

Such measurements as input, output, and temperature, however, are almost meaningless unless procedures can be duplicated from one test to the next. The same brake lining, for example, will wear more doing the same amount of work at a high temperature than at a lower one. Thus, it's necessary to maintain close control over brake dynamometer tests. Where temperature control is used for routine wear cycles, a recording potentiometer is employed. Where time interval governs the cycle, a simple timer is used.

Overall severity of a test also depends on the total amount of work done. Consequently, controls to set the number of cycles and counters to count them are necessary.

A control for keeping brake torque constant is a must for many tests. (In some tests, brake effectiveness is determined by keeping input constant and observing brake output.) Various means, including manual manipulation, have been used for controlling torque on brake dynamometers, but this control has not lent itself to standardization.

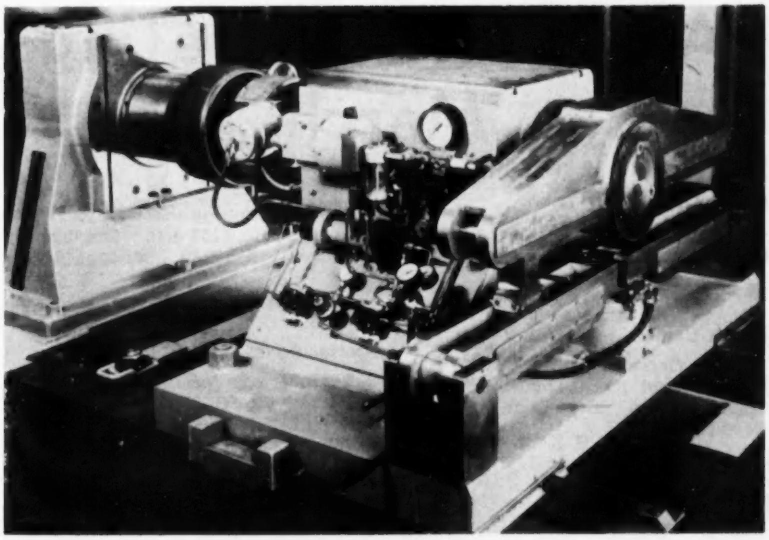


Fig. 1—This shows the "brake" end of a brake-testing inertia dynamometer. The rotative force in the torque arm, which indicates the output of the brake, is measured by various devices

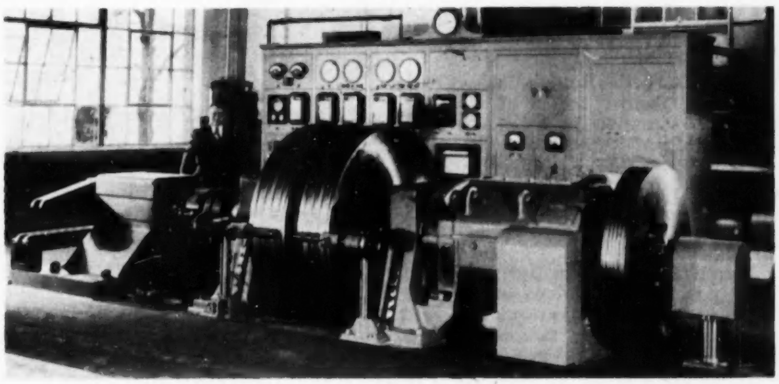


Fig. 2—This view shows the complete setup for testing brakes with an electric-driven inertia dynamometer

Dynamometer Tests Go Just So Far

Brake testing dynamometers can go just so far. They cannot, and are not expected to, replace road tests. Instead they're meant to supplement and shorten road tests.

Linings and drums can be screened in jig time on dynamometers and the most likely ones selected. Instrumented dynamometer studies often provide clues to ways to reduce brake chatter, temperature, deflection, and

Continued on Page 122

SAE Section Meetings

March

Atlanta—March 16

Dinner 7:15 p.m., meeting 8:15 p.m. Fuels. Speaker to be announced.

British Columbia—March 9

Hotel Georgia. Dinner 6:30 p.m., meeting 8:00 p.m. Dual-Fuel Diesel Engines—John Brynelsen, Simson-Marwell, Ltd.

Buffalo—March 17

Hotel Sheraton, Buffalo. Dinner 6:00 p.m., meeting 8:00 p.m. What's New in the 1953 Cars—Joseph Geschelin, Detroit editor, Chilton Co. National SAE President's Night—Robert Cass.

Canadian—March 18

Roof Garden, Royal York Hotel, Toronto. Dinner 7:00 p.m., meeting 8:00 p.m. Engineering Frontiers—1953 SAE President Robert Cass.

Central Illinois—March 23, April 8 and 9

March 23—Jefferson Hotel. Dinner 6:30 p.m., meeting 7:45 p.m. The Torque Converter Transmission will eventually replace Selective Gear Transmissions in Passenger Vehicles (Student Debate). University of Illinois (Student Group) versus Bradley University (Student Group).

April 8-9—Earthmoving Industry Conference (see page 107 of this issue for complete program).

Colorado—March 19

Coleman Motors. Meeting 8:00 p.m. Field Trip through Coleman factory.

Indiana—March 12

Marott Hotel. Dinner 7:00 p.m., meeting 8:00 p.m. Turboliner—D. J. Nolan, Allison Division, GMC.

This is not a complete list of all Section Meetings. It includes only those meetings for which we have received sufficient advance notice to permit listing.

Kansas City—March 30

Roselli's Restaurant. Dinner 7:00 p.m., meeting 8:00 p.m. Engineering Frontiers—1953 SAE President Robert Cass.

Metropolitan—March 11

Engineering Societies Building, 29 West 39th Street, New York. Meeting 7:45 p.m. GM Model 51 Diesel Engine—John Dickson, chief engineer, Diesel Engine Division, GMC.

Milwaukee—March 13 and March 20

March 13—Marquette University, Science Bldg., Room S-100, 1217 W. Wisconsin Ave. Meeting 7:30 p.m. Lecture Meeting. Valves and Valve Gear Design—Vincent Ayres, Eaton Mfg. Co.

March 20—Marquette University, Science Bldg., Room S-100, 1217 W. Wisconsin Ave. Lecture Meeting. Meeting 7:30 p.m. Engine Characteristics and Tests—W. Greve, Le Roi Co.

Mohawk-Hudson—April 7

Circle Inn, Latham, N. Y. Dinner 6:45 p.m., meeting 8:00 p.m. Machine Tools and the Tool Engineer—E. W. Dickett, Sundstrand Machine Tool Co.

Montreal—March 19

Mount Royal Hotel. Engineering Frontiers—1953 SAE President Robert Cass.

Northwest—April 3

Dinner 6:30 p.m., meeting 7:30 p.m. Preventive Maintenance—Dare H. Mikkelson, Los Angeles-Seattle Motor Express.

Philadelphia—March 11

Engineers' Club of Philadelphia. Dinner 6:30 p.m., meeting 8:00 p.m. Engineering Frontiers—1953 SAE President Robert Cass. This meeting will be designated "Presidents' Night."

St. Louis—March 9

Gatesworth Hotel, 245 Union Ave., St. Louis, Mo. Dinner 7:00 p.m., meeting 8:00 p.m. Slides and panel to discuss 168.5 Miles per Gallon of Gasoline—L. S. Echols, Shell Oil Co. Film—Mobilgas Economy Run.

Southern New England—April 2

Hartford Golf Club. Dinner 6:45 p.m., meeting 8:00 p.m. Ramjet Fuels and Combustion—John P. Longwell, Esso Laboratories.

Spokane-Intermountain—March 13

Caravan Inn. Dinner 7:00 p.m., meeting 8:00 p.m. Fleet Maintenance—Clarence Bear, Hudson House, Inc.

Texas—April 3

Railroad Diesel Engines—W. F. Kascal, Texas and Pacific Railroad. Guest—1953 SAE President Robert Cass.

Houston Division of Texas Section—March 13 and April 2

March 13—Diesel Engine Service Problems—A. Brecht, Detroit Diesel Engine Division, GMC.

April 2—Engineering Frontiers—1953 SAE President Robert Cass.

Twin-City—March 11

Curtis Hotel. Dinner 6:30 p.m., meeting 8:00 p.m. Deposits in the Diesel Engine—H. M. Gadebusch, Detroit Diesel Engine Division, GMC.

Washington—March 17

Burlington Hotel. Dinner 6:15 p.m., meeting 8:15 p.m. Commercial Air Transport Developments—William Littlewood, American Airlines, Inc.

Western Michigan—March 17

Bill Stern's Steak House. Dinner 6:30 p.m., meeting 8:00 p.m. Automatic Transmissions—Walter B. Herndon, Detroit Transmission Division, GMC.

Wichita—March 31

Engineering Frontiers—1953 SAE President Robert Cass.

Williamsport—April 6

Antler's Country Club. Dinner 6:45 p.m., meeting 8:00 p.m. Power Steering—Francis W. Davis, consulting engineer, Waltham, Mass. Models will be exhibited illustrating the development of power steering.

SAE Section Meetings

Says Lack of Money Only Bar to Space Travel

• Central Illinois Section

R. B. Applegate, Field Editor

Jan. 26—**Dr. Walter Dornberger,** who headed Germany's rocket operations for Hitler during World War II and who is now a guided missile specialist with Bell Aircraft Corp., addressed approximately 250 members and guests. His talk on "Guided Missile Development in the Past, Present, and Future" described the development of the German V-1 and V-2 rockets before and during World War II.

The fact that Hitler had dreamed that no such weapon would ever be launched against England delayed the development of rocket warfare several years. However, when Hitler was convinced that rockets were of military value, the necessary funds for full development were made available. This resulted in the V-1 buzz-bomb and later the V-2, both of which wrought havoc in the bombardment of England. The first rocket was launched on Sept. 6, 1944, and from then to March 27, 1945, some 4320 were launched.

The troubles encountered in the development of a guided missile were many and varied. One model was abandoned completely as a "lemon." In July, 1943, three explosions in a row on the launching ramp convinced Dr. Dornberger and his associates that the rocket was only as perfect as its smallest component part. All three blasts were caused by small failures, but it took months to find the trouble. In September, 1943, 600 British bombers bombed the rocket factory, but none of the vital research buildings were hit, and the factory was again running full tilt in less than four weeks.

Dr. Dornberger mentioned that one-fourth of his top "teams" is now working for the Russians.

Dr. Dornberger skipped the story of Germany's defeat, his capture by the allies, the years at Wright-Patterson Air Force Base at Dayton, Ohio, and his latest job with Bell Aircraft Corp. as a guided missile specialist.

He came to the present day with a rush and stated that guided missiles will make the conventional bombers obsolete—unless we send the bombers at much higher altitudes and greater speeds.

Space travel is Dr. Dornberger's one dream, and he dwelt on it last and lovingly. Today, he stated, it is technically possible to take a trip to the moon or Mars, with the available fuels and powerplants. Lack of money is the only drawback, since no nation is willing to invest the necessary 10 billion dollars.

For a flight to Mars, we would first have to build a satellite (man-made planet) 500 miles away from earth. We could haul the material for it in shuttle rockets and, when it was constructed, we could bring up the parts for the space ship and assemble it close to the satellite. From there, it would be easy to "blast off" for the stars at two miles a second.

At the end of his talk, Dr. Dornberger was bombarded with questions on all phases of space travel. One question as to the commercial value of such a satellite as has been described was answered thus: "We could contact a soft-drink manufacturer, tell him we would build his name in letters ten miles high out there in space and guarantee this sign would circle the earth every two hours forever. What don't you think he would pay for an ad like that?"

E. W. Landen, staff physicist in the research department of Caterpillar Tractor Co., was the technical chairman and introduced Dr. Dornberger.

Gives History Of Aero "Commander"

• Wichita Section

Jay H. Whoolery, Field Editor

Jan. 21—**T. R. Smith,** vice-president of Aero Design and Engineering Co. covered the design and construction of the Aero Commander aircraft and gave a word picture of the set-up of Aero's factory.

The Aero Commander project was initiated in late 1934. The basic design was to provide a new airplane especially for business, an aircraft of high performance, good load-carrying ability, and one that would provide the same level of safety and performance found in the DC-3—an airplane of such a design that the business man could operate it himself.

By late 1946 there was sufficient de-

A trip to Mars or to the moon is technically possible today, Dr. Walter Dornberger told members of Central Illinois Section at the Jan. 26 meeting. Left to right: E. W. Landen, technical chairman of the meeting; Dr. Dornberger; Section Chairman J. T. Liggett; and Program Chairman J. H. Smith

tailed engineering data available to start producing the proto-type aircraft—tools, equipment and templates were all constructed at that time. The aircraft made its first flight April 23, 1948.

The airplane is a high-swing, tricycle landing gear type; it has all metal construction, with an estimated cruise speed of 180 mph. It was to carry five persons with a 750 mile range and hold an 8,000 foot ceiling with one engine feathered. Later a 260 hp Lycoming Engine replaced the 190 hp Engine, and the gross weight was increased from 4600 to 5500 lbs.

Aero Design has produced 55 aircraft to date and is producing 5 aircraft per month. There are now 600 employees in the plant. Smith ended his talk with a picture description of a tour through the plant.

SAE President Robert Cass (left) looks over a C.A.B. report with speaker Joseph O. Fluet (right) at the Feb. 4 meeting of Southern New England Section. In the center is technical chairman Herbert M. Toomey, who presided over the air safety meeting

Analysis of Accidents First Step in Prevention

• Southern New England Section

A. D. Nichols, Field Editor

Feb. 4—The cause of an aircraft accident, minute as it may be, emerges with careful investigation, stated **Joseph O. Fluet**, chief of the Bureau of Safety Investigation, Civil Aeronautics Board, speaking before about 70 members and guests of the Southern New England Section.

Fluet was in charge of the investigation of the three recent Elizabeth, N. J., accidents and also the Jamaica Bay accident. He pointed out the difficulties under which an investigator must work in such a situation. Information as to the causes of these accidents was very meager and the work was carried out amidst a crowd of spectators.

After an accident, one of the first steps is to identify all damaged parts and then determine whether these parts were damaged before or after the impact. All parts must be accounted for and catalogued. During the course of an investigation all persons having any knowledge of the accident are questioned, and in the hearings representatives from the pilots', navigators', flight engineers', stewards', and stewardess' associations and the aircraft manufacturing companies are present. Fluet stated that there are two major items to be investigated after a crash. They are: (1), the aircraft and its component mechanical parts, and (2), the crew. The aircraft has certain limitations which are known by the investigator. The human element is less tangible, and this part of the investigation is often very difficult.

The Civil Aeronautics Board is composed of about 100 employees, including 28 investigators who must look into all domestic and foreign accidents of United States Air Carriers. It suggests changes which might be made in an aircraft to prevent further accidents. One of the results of action taken by the C.A.B. is the daily mechanical report all airline operators must make for each aircraft. Any unusual incident must be reported by the pilot or crew and recorded. Fluet said that there is no set rule for accident prevention, but cause determination is the first step toward prevention.

Visitors at this meeting included SAE President Robert Cass. President Cass spoke briefly concerning the substitution and conservation of metals and material which must be studied by engineers today. He also pointed out that engineers must learn more about management, since more and more of them are getting into this field.

Robert Cass (left), SAE president for 1953, chats with Syracuse Section Chairman Charles Spase at the Feb. 6 meeting. At right, officers of Syracuse Section hold products made by their companies. Left to right: Vice-Chairman Claude Bigelow—who was excused from holding one of the giant trucks put out by Brockway Motor Co.; Secretary Robert S. Root of Lipe-Rollway Corp.; Elmira Vice-Chairman Robert W. Sutton of Eclipse Machine Division of Bendix; Chairman Charles Spase of Lipe-Rollway; Sidney Vice-Chairman Walter J. Spengler of Scintilla Magneto Division of Bendix; and Treasurer David T. Doman of Porter-Cable Machine Co.

Cass Urges Search For Materials Substitutes

• Syracuse Section

Feb. 6—**Robert Cass**, SAE president for 1953, warned that the automotive industry must meet the problem of finding substitutes for essential materials "taken from civilian industry by the government's mobilization program."

"We have reached the level now where we should know what to do about nickel, cobalt and the other vital metals," he pointed out. One example of how the automotive industry is facing up to the situation, Cass said, is that nickel is being taken out of cars wherever possible.

The stockpiling program of the government of necessity creates materials problems in industry, he said. "We must be responsive to the government's demands for metals."

Cass further stressed that proper emphasis be given to research "in the most economical manner."

"In the past," he said, "most engineers, while not necessarily anti-social, have not necessarily been responsive or fully informed of the management's side of a company." He believes engineers should become familiar with "material costs, the competing claims of budgets and the source of money-making possibilities."

"Everyone agrees that the world into which we are moving will see revolutions now being conjured up by the scientists. They call for engineering to assume much greater importance in this world.

"Engineers—and particularly the younger engineers—should be re-examining the basic training they have had and see that they avoid the danger of too much specialization," Cass concluded.

A former director of the Motor Vehicle Division of the National Production Authority in Washington, D. C., Cass is assistant to the president of the White Motor Co. of Cleveland.

Economy Runs Set Par for Motorists

• Chicago Section
D. J. Schrum

Jan. 26—Mileage is determined by the motorist. How he drives and how he maintains his car controls the gasoline mileage he obtains. This was proven in the 1950, 1951, and 1952 Mobilgas Economy Runs described by **H. S. Kelly** of Socony-Vacuum Oil Co. at a dinner meeting attended by 140 members and guests of the South Bend Division of the Chicago Section.

While these runs serve the purpose of advertising for the sponsor, they also bring to the public and the automobile industry the knowledge of the mileage available in the present cars and how to attain it. It is a significant fact that, in spite of improvements in engine performance and fuels in the last ten years, the average motorist still obtains about the same average of 15 miles per gallon.

The 1950 run, being the least restricted, credited the extremes of tune-up procedure, selection of parts, and special preparation for scores as high as 26.52 mpg and an average of 22.1. The 1951 run limited special preparation so the entrants turned to careful practice runs and relied on skillful driving with the amazing average of 23.9 mpg.

The 1952 run was planned to eliminate the advantages of the entrants in the previous runs and reduce it to nearer conditions met in actual customer driving. Destination and route were not announced until a short time before the run to limit practice runs. Tune-up and special parts options were not permitted. The length of the course was also increased to include a wider range of climate and terrain. Thus the results represented the built-in economy of the cars themselves when operated at their best advantage, giving an average for the field of 22 mpg.

In this way the Economy Runs are

Technical Chairman W. J. Harris (left) talks with Speaker H. S. Kelly (right) of Studebaker at the Jan. 26 meeting of South Bend Division of Chicago Section

Two 35-year members of SAE received certificates at the South Bend Division meeting. At left, E. M. Schultheis receives the framed certificate from M. P. deBlumenthal; at right, deBlumenthal presents certificate to Edwin B. Ross

setting a par for gasoline mileage and showing the motoring public how to reach it. The importance of the program was emphasized in the statement that an increase of one mile per gallon in the automobiles of this country would save 1,800,000,000 gallons of gasoline annually at 375 million dollars.

Prior to the technical program conducted by W. J. Harris of Studebaker, certificates were presented for twenty-five and thirty-five year memberships by M. P. deBlumenthal. Ten members received awards for twenty-five years of membership and E. M. Schultheis and Edwin B. Ross of Clark Equipment Co. were honored with thirty-five year certificates.

Says Space Travel Must Await Research Data

• Philadelphia Section

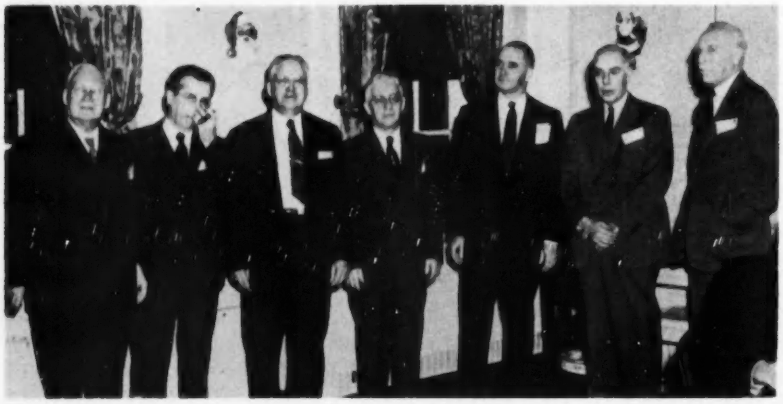
Joseph A. Daley, Jr., Field Editor

Dec. 10—A talk that was "out of this world" was presented by **Dr. I. M. Levitt**, director of Fels Planetarium at the Franklin Institute, speaking on the mechanical and physiological aspects of space travel.

After orienting his audience in the physics of space travel, Dr. Levitt reviewed the proposed methods of establishing, supplying and manning the space stations that would be necessary.

While some rocket and space authorities currently feel that the accomplishment of their aims is limited only by lack of funds, Dr. Levitt believes that the many physiological and psychological experiments under way must show clearly defined results before any expenditure for construction can be justified.

At the dinner preceding Dr. Levitt's talk, seven Philadelphia Section members were presented with 35-year membership certificates by Chairman R. W. Donahue, and 14 received 25-year certificates. The Section has a total of 14 35-year members and 40 25-year members.



Honored for their 35 or more years of SAE membership at the Dec. 10 meeting of Philadelphia Section were (left to right) Thorsten Y. Olsen, Frederick L. Creager, Cecil M. Billings, L. M. de Turk, W. S. Johnston, Richard A. Watson, and John Warren Watson

Sees Establishment Of Platform in Space

• San Diego Section

Paul L. Brady, Field Editor

Jan. 21—The development of rocketry and its role in science and political influence was discussed by **Dr. Wernher Von Braun**, technical director of the Guided Missile Development Group at Redstone Arsenal in Huntsville, Ala. The talk was presented at the annual dinner meeting of the San Diego Sections of SAE and the Institute of Aeronautical Sciences.

Von Braun stated that the rapid obsolescence of such craft as the B-36 and the limited life of future trans-sonic bombers as a result of super-sonic guided missiles and interceptors suggests a better method of attaining a "big stick" over would-be aggressors. This method is the development of rockets capable of transporting the necessary materials to outer space for the creation of a space platform.

He presented graphs, cross-sectional drawings, and other illustrations to aid the members and guests in envisioning the size of equipment and magnitude of problems which would be encountered.

His concept of a flight pattern for his rocket was in the form of a trajectory rather than a straight vertical path. In this manner the missile would attain an orbital pattern around the earth in a northeast to southwest direction. The most habitable parts of the earth would be under observation at least once every 24 hours, thus providing an ideal flight pattern for military reconnaissance.

Establishment of a space station some 1000 miles from the earth's surface was envisioned by Wernher Von Braun (right), technical director of the guided missile development group at Redstone Arsenal, at the joint meeting of the SAE and IAS San Diego Sections Jan. 21. Technical chairman was Hans Friedrich (left)

The orbit of the rocket outside the atmosphere of the earth was fixed at an altitude of 1075 miles above sea level, which approaches four times the altitude reached by a two-stage rocket fired in the United States. To accomplish the increase in altitude using fuels presently available, he would design a three-stage rocket. The first two stages would be jettisoned as the fuel expanded. The third stage would carry the passengers, 35 tons of cargo, and fuel to reach the final altitude and return to earth. Controls, wings and other equipment necessary for the safe conduct of the passengers back to earth were included in the design of the third stage.

Von Braun noted that to attain the proper balance between centrifugal force of flight around the earth and the earth's gravitational attraction, the rocket ship must attain a speed of 18,468 miles per hour. This means that the earth would be circumvented once every two hours.

Since the ship's space would be limited, Von Braun described a method of constructing a space platform with a configuration of a huge tire. The structure consists of some twenty sections of plastic material inflated by a pressurization system. This platform houses the scientific apparatus necessary to control remotely located telescopes for photographing earth and astral objects. In addition, the application of known guidance equipment

SAE Central Illinois Section

Earthmoving Industry Conference

Hotel Pere Marquette
Peoria, Illinois
April 8-9, 1953

Wednesday, April 8
9:30 a.m.

Welcome
J. E. Jass
General Chairman of Conference

Keynote Address
R. S. Stevenson
Allis-Chalmers Mfg. Co.

Technical Chairman
T. M. Fahnestock
Caterpillar Tractor Co.

Electric Drives for Earthmoving and Construction Machinery
D. K. Heiple, R. G. LeTourneau Co.

2:00 p.m.

Technical Chairman
R. H. Hunger
Caterpillar Tractor Co.

Asphalt Paving Machinery and Methods
R. C. Heacock, Barber-Greene Co.

Air Compressor Equipment Applied to Earthmoving Projects
D. O. Meek, Gardner-Denver Co.

Wednesday, April 8
6:30 p.m. **Ballroom**

BANQUET

Cal Tinney
Humorist, Author, and Entertainer

"Cal Tinney Says"
"The Earthmoving Industry Conference Banquet has proved to be one of the high points of every one of the last three conferences."
We feel certain that the home spun philosophy and humor of "The Sage of Wildhorse Hill" will provide you with an entertaining evening.

J. T. Liggett
Chairman, Central Illinois Section
Toastmaster

Only 550 people can be accommodated at this banquet, so order your tickets early.
Tickets are $4.50 each.
Please make checks payable to Earthmoving Industry Conference, and mail to Mr. H. R. Johnson, 534 Hollyridge Circle, Peoria, Illinois.

Thursday, April 9
9:00 a.m.

Technical Chairman
T. J. Flamm
Allis-Chalmers Mfg. Co.

The Use of Strain Gages to Develop Earthmoving Machinery
W. T. Bean, Jr., Research Consultant, Detroit

Prepared Discussion:
L. D. Gilmore, International Harvester Co.

Transportability of Earthmoving Equipment
H. W. Rockwell, Allis-Chalmers Mfg. Co. Cedar Rapids Works

Prepared Discussion:
H. H. Harrison, Illinois State Highway Department
Prepared Discussion:
Jack Hartman, Swords-McDougal-Hartman Construction Co.

1:30 p.m.

Technical Chairman
K. L. Mason
Caterpillar Tractor Co.

The Emergence of Foreign Competition
W. Blackie, Caterpillar Tractor Co.

A Look Toward the Future
G. H. James, James Construction Co.

Hotel Reservations

Write or wire at once to Hotel Pere Marquette, Peoria, Illinois. Be sure to state that you are coming to the SAE Earthmoving Industry Conference.
If this hotel cannot accommodate you, your request will be forwarded to another hotel for room assignment.

Students Tour Continental

Philip S. Webster (far left), student activity chairman of Western Michigan Section, arranged a tour of the metallurgical and experimental laboratories of Continental Motors Corp. for 14 students of Muskegon Community College on Dec. 18. Following the tour, the students saw a film on foundry operations loaned by Campbell, Wyant and Cannon Foundry Co. Professor Hawley of Community College (at right, with hat and coat) accompanied the students.

could be used to direct missiles toward earth carrying lethal warheads to neutralize any enemy uprising.

The speaker was introduced by Hans Friedrich, technical chairman, who summarized Von Braun's accomplishments. These included his experimentation with liquid fuel rocket motors as early as 1930. In 1937, Von Braun was made technical director of the German Guided Missile Center at Peenemuende, which at the peak of its activity employed more than 10,000 people. In this capacity, he is credited with the development of the A-3, A-5, and the V-2 rockets and anti-aircraft guided missile "Wasserfall."

Power Steering Allows Basic Design Re-evaluation

• Metropolitan Section

S. G. Tilden, Jr.

Feb. 5—"Power steering, by eliminating the effects of larger and softer tires and heavy front ends, makes it possible to re-evaluate all the factors involved in the design of front suspensions and in the geometry of steering linkages," said **Francis W. Davis** in a paper entitled "History, Development, and Application of Power Steering."

"It thus seems reasonable," he continued, "to expect not only steering ease and greater safety, but an improvement in car stability and cornering characteristics at all driving speeds, and under all road surface conditions."

Davis, a consulting engineer from Boston, began working on power steering servo systems in the early 1920's. His basic research, basic patents, and his constant efforts for universal adoption have earned him the title "Father of power steering."

After being introduced by Charles E. Chambliss, Jr., vice-chairman of passenger car and body activity, Davis showed the evolution of the steering gear from plain linkages, through worm and sector systems to the hydraulic, pneumatic, and mechanical servo follow-up systems of power steering known today. Coincidental with this evolution, he explained, has been a greater steering load imposed by increased tire sections, lower tire inflation pressures, and a general increase in vehicular weight. This added weight is concentrated more and more on the front wheels. This has forced a steering gear ratio increase of three or four times that of earlier high pressure tires.

As proof of the growing public acceptance of power steering, Davis quoted the following production figures on power steering units over the last three years:

1950—10,000 units of heavy duty equipment

1951—50,000 units combined passenger car and heavy duty

1952—275,000 units combined passenger car and heavy duty

"Due to the increased production, the prices of the units are beginning to move downward," he commented.

Describing different power steering systems with the aid of slides, Davis pointed out some of the problems encountered in development and how they were resolved. One of these was the natural tendency for any basic servo follow-up system to overrun, oscillate, or hunt. Another was the design of a hydraulic system with a reasonably constant volume flow through the full range of engine speed.

To the eternal question of full-time power steering versus the part-time or power assist systems, Davis commented simply "the public will furnish the answer." He continued, saying that it is a relatively simple matter in either case. The only difference in the two is that the power assist system utilizes a centering spring which must be compressed or overridden manually before the servo follow-up system is actuated.

Speaking of maintenance, Davis quoted case histories that showed excellent life with a bare minimum of upkeep even under severe military use.

Robert Cass, president of the Society of Automotive Engineers, was introduced by Leslie Peat, chairman of the Metropolitan Section, as was John A. C. Warner, the Society's secretary and general manager.

Space Navigation Not Yet Practicable

• Dayton Section

T. L. Deger, Field Editor

Jan. 15—Space navigation in the interplanetary system is still largely theory and far from reality, stated **Dr. John Clemens**, chief of the Flight Research Laboratory at Wright Air Development Center, at the annual joint dinner meeting of 300 members and guests of Dayton Sections of the SAE and Institute of the Aeronautical Sciences.

In covering the subject "Mechanisms in Navigation," Dr. Clemens stated that space navigation evolves basically around the inertial space reference, the earth coordinate system and time, and that experience to date has shown that a better comprehension of the true

vertical is necessary as well as the elimination of effects of acceleration. In conjunction with his talk, Dr. Clemens displayed and explained a working model of a Shuler pendulum.

Prior to Dr. Clemen's talk, members and guests were treated to the first public showing of the film "Now for Tomorrow." This film is a resume of the work which Wright Air Development Center is doing for the progress of flight.

Rocket Progress Behind Iron Curtain

• Southern California Section

P. Kyropoulos, Field Editor

Jan. 15—Data on the little-known subject of Russian technical development was given by **George B. Sutton**, supervisor of the propulsion analysis group at North American Aviation, Inc., in his paper on "Rockets behind the Iron Curtain."

The paper given by Sutton was the first comprehensive story of Soviet rocket activities to be published in the free world. It gave a glimpse of what the Russians are doing to create new and potent military weapons, and presented a detailed discussion on the subject.

This outline on rocket development was also presented to the American Rocket Society in New York in December, and created widespread interest both there and here.

For the past ten years George B. Sutton has held responsible positions in the rocket and guilded missile industry. He has written technical articles on rockets and missiles and the only recognized engineering college textbook on rocket propulsion, and has made a special study of Russian rocket development.

High Speed Camera Aids Design Engineer

• Kansas City Section

Samuel Melo, Field Editor

Jan. 22—A camera that can stretch the events of one second into 42 days, the O'Brien Ultra Speed Camera, was described at the January meeting. This instrument is capable of taking pictures at a rate of 22 million frames per second.

Perhaps less spectacular, but more practical as an engineering tool, is the Kodak High Speed Camera described and demonstrated by **Robert Woodward** of Eastman Kodak and **Bill Terrell** of Hanks Terrell, Inc., Oklahoma specialists in high speed industrial photography. The Kodak High Speed Camera, an engineering instrument for magnification of time, is a non-intermittent motion picture camera which

NATIONAL OIL SEAL LOGBOOK

Write our Redwood City office for reprints of this page

Sealing News & Tips

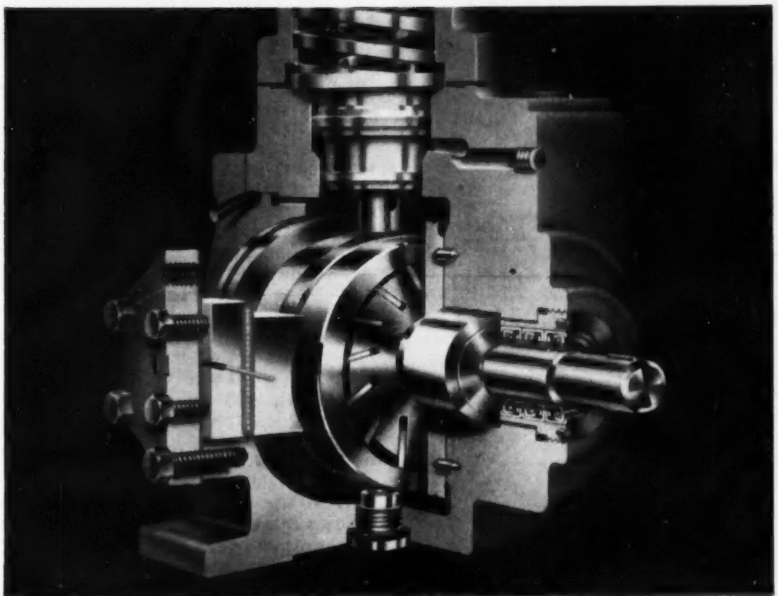


Figure 1 — Racine Model "F" Pump

Standard-design National Oil Seals, O-Rings give effective, low-cost sealing in Racine Pump

An unusual and highly economical solution to a two-way sealing problem is found in the shaft bearing assembly of Racine Hydraulic's Model "F" Pump.

Where the shaft enters the pump (Figure 1) it is necessary to prevent leakage of hydraulic oil (200 S.S.U. at 100°F) as well as intake of air, dust, and dirt. Pressure varies from slight suction to 25 p.s.i. Shaft speed averages 1,200 r.p.m. and the pump may be in continuous operation over long periods of time. External abrasive conditions are often very severe.

The unusual approach of Racine's engineers is to employ three single-lip National seals. All are modified National 50,000-S Syntech* seals—spring-tensioned units with precision-trimmed synthetic rubber sealing members inside a steel outer case. Two such seals are mounted with sealing lips inward to retain pressure and oil. The third seal is mounted outward and operates virtually "dry" as a dust excluder.*

On the faceplate assembly opposite the sealing point, Racine solves a static sealing problem economically with a commercial-grade O-Ring also supplied by National.

Racine's use of standard-design National seals not only expedites seal deliveries but saves tooling costs. Whether your application utilizes standard-design seals or requires special seal design, National Applications Engineers are at your service.

Figure 2 — National 50,000-S series Syntech (Modified)

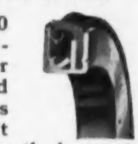
Note: This application shows that National seals may be used under conditions more severe than intended. However, before exceeding seal performance specifications, discussion with the nearest National engineer is recommended.

Trade Mark Registered

Dual-Lip Opposed Syntech Seal

National 70,000-S Syntech seals are used in numerous applications where fluids or lubricants must be separated within a housing. Sealing lips are of synthetic rubber, precision-trimmed to a "knife" edge for positive sealing, mounted in opposed position and spring-tensioned. They are capable of continuous operation with zero leakage at intermittent temperatures up to 300°F, speeds to 7,000 F.P.M. and run-out to .030 indicator reading.

External Expansion Leather Seals



National 80,000 series spring-tensioned leather seals are designed for applications where the shaft remains stationary, the bore rotates, and the centrifugal force would impair operation of a shaft-type seal. Use of this external design in such cases often simplifies machinery design and facilitates assembly.

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National Shims and Shim Seals are available in a wide range of sizes and shapes and in all thicknesses from .002" upward. The uniform density of metals employed prevents compressing under severe pressure. National Shims are used by all leading vehicle, equipment, and machinery manufacturers. For complete information, request Catalog 93.

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MILWAUKEE, WIS. . . . *647 West Virginia Street, BRoadway 1-3234*
NEWARK, N. J. . *Suite 814, 1180 Raymond Blvd., MItchell 2-7586*
REDWOOD CITY, CALIF. . . *Broadway and National, EMerson 6-3861*
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can take from 1000 to 3000 pictures a second on standard 16 mm film, in black and white or color.

Such speed is made possible by a revolving framer-shutter of plate glass rotating at 90,000 rpm, and permitting exposures as short as one-15,000th of a second. When the processed film is run through a standard projector at 16 frames per second, action which is only a blur to the human eye may be slowed down almost two hundred times, for engineering analysis. Frame size is large enough to show fine details clearly in individual enlargements.

The camera mechanism is driven by a motor operating on 115 v a-c or d-c. Power is cut off automatically when all film has been exposed (about 1½ seconds operating time with 100 feet of film at maximum speed). A built-in timing device permits electrical linkage of the camera to the subject mechanism.

An attachment consisting of a silver mirror and a side lens makes it possible to record the wave patterns of an oscilloscope on the edge of the film, for accurate analysis of electronically controlled devices. Lenses of three different focal lengths (F:2) are available.

With this research instrument, engineers can freeze motion in operating mechanisms such as cams, relays, breaker points, springs, and so forth, to study stresses, patterns of motion and eventual failures, permitting a perfection of design not possible otherwise by conventional methods.

Traces History Of Guided Missiles

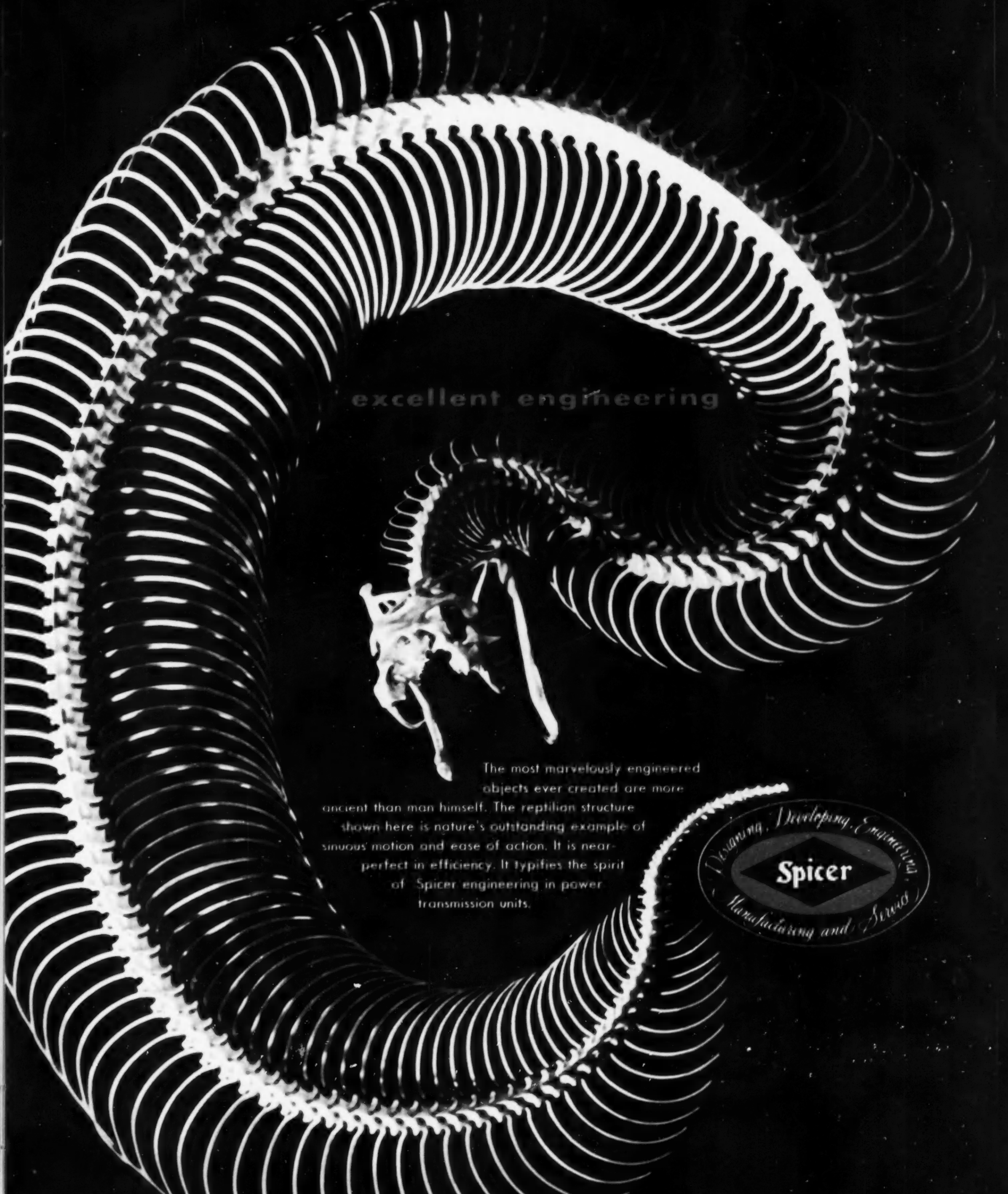
• Western Michigan Section

A. L. Maring, Field Editor

Jan. 20—"Automatic Pilots and Guided Missiles" was the title of a talk given by **William F. Carr**, electro-mechanical project engineer of Lear, Inc. Carr has been with Lear since 1946, and has designed and invented many products in the photographic and electronic fields. Carr was introduced by Wayne Johnson, technical chairman, also of Lear.

Carr described what an automatic pilot is and how it operates. The automatic pilot eliminates the fatigue and drudgery of flying, and is safer and more accurate. Interesting stories of actual performance of automatic pilots were told by Carr. The automatic radio-controlled field approach and landing systems were also described.

A missile is described as an object that is thrown, hurled, or shot, such as a stone or rock. But nowadays a missile is commonly thought of as a radio- or radar-controlled rocket. The history of the guided missile was traced from its beginning in the proximity fuse on aircraft shells to the German buzz bombs, the German V-2 rockets, and finally to present-day rockets. These can be launched at any point in the world and hit a target anywhere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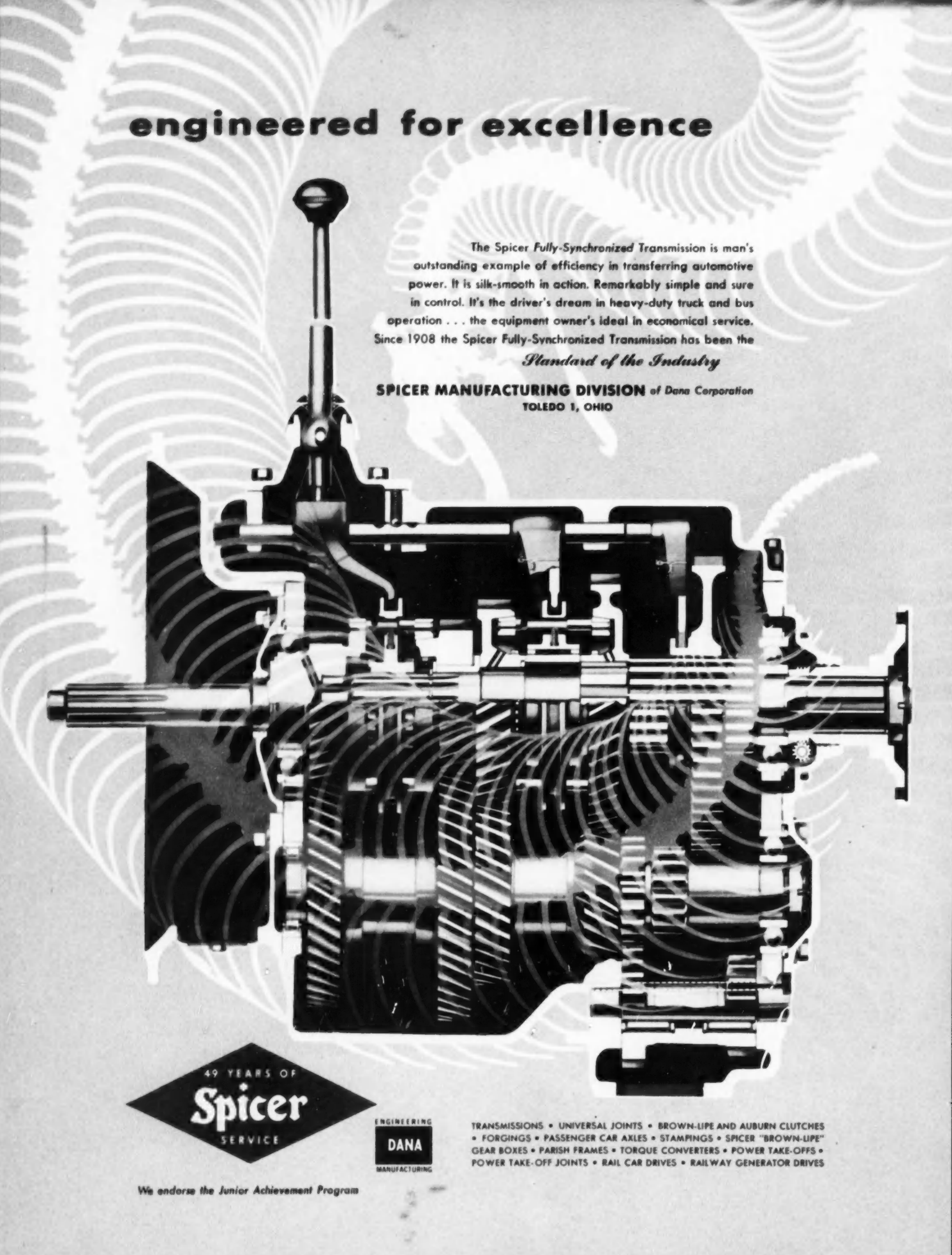
Manufacturing and Service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else in the world within a range of **300 yards**.

Carr said that jet pilots in Korea are loading their wing tip tanks with rocks and releasing the rocks upon the enemy. So after all these years of progress, we have returned to throwing rocks as missiles.

Credits Additives For Racing Car Speed

• Williamsport Section

Paul Cervinsky, Field Editor

Feb. 6—The faster speeds of today's racing car can be attributed more to the additives placed in the gasoline tank than to changes in the design of the engine or race car, stated **R. T. Jackson**, Perfect Circle Corp., before 75 members and guests of the Williamsport Group.

The injection of so-called "pop" into the fuel has boosted the performance of the engine to unbelievable power, and only good design of engine and car will result in a winner at the guelling 500 mile speedway classic.

Each part and section of the modern American racing machine was described by the speaker and illustrated with slides.

The showing of the film "Fastest Five Hundred" concluded the activities for the evening.

Finds Additives, Lead Chief Causes of Wear

• Cleveland Section

Jan. 19—Wide consideration was given to the subject of engine wear at the January meeting when a special discussion group as well as the principal speaker was scheduled in a four-star program. The speaker was **Robert J. Pocock** of the engineering research department of the Ford Motor Co. Title of his paper was "Can All Engine Wear Be Trapped in a Can?" Three authorities forming the discussion group were asked to discuss the paper and the subject following Pocock's talk. Those in the panel were W. D. Myers of the Socony-Vacuum Oil Co.; J. L. Taylor of the Gulf Research & Development Co.; and J. L. Palmer of the Lubrizol Corp.

Principal speaker Robert J. Pocock of Ford outlined what his company had done to investigate the causes of engine wear and what the results revealed. The survey was conducted with cars in the company fleet to determine internal engine wear in operations typical of the average driver. Base and leaded fuels were used as well as base and additive oils, and various cleaners and oil filters were employed.

With the aid of slides showing charts and graphs, Pocock pointed out the

results in the way of wear on the cylinder bore, rings, main bearings and connecting rod bearings under varying conditions of oils, fuels, and filters. In general, the survey revealed that wear was increased for the most part by the use of oil additives and by the use of leaded fuels, particularly in the case of bearings, piston rings, and so forth.

Since the lubricating oil plays such an important role, data were supplied on effective control with the use of different systems of oil filtration. The full-flow oil filter was found to be the best method for restricting wear in an engine as a result of contaminants that get inside. A reduction in engine octane requirements, until better and cleaner fuels can be produced in quantity to suit our needs, would lessen the contaminant load and improve piston ring operating conditions.

Following Pocock's paper, the discussion panel took up the subject and offered the results of their own experimental work. As this is a controversial subject, some of the findings varied considerably from those in Pocock's paper while others strongly supported him.

J. L. Taylor of the Gulf Research & Development Co. used slides to show the results of tests with different oils and fuels at varying temperatures. W. D. Myers of Socony-Vacuum Oil Co. discussed the work of his laboratory and test findings with engines operating at different temperatures. J. L. Palmer of the Lubrizol Corp. offered results of Lubrizol tests with oil additives.

The meeting was capably conducted by Raymond I. Potter of the Standard Oil Co. of Ohio.

Economic Factors In Usefulness of LPG

• Colorado Group
Robert F. Brown, Field Editor

Jan. 15—Presenting a paper on "LPG As An Automotive Fuel" prepared by **L. J. Barney**, automotive engineer for Socony-Vacuum Oil Co., **W. S. Johnson,** district manager for that concern, outlined the economic factors which influence the choice of this fuel.

It was pointed out that there are increased supplies of LPG but that distribution over the U. S. is poor and the price fluctuates to a greater degree than with gasoline and diesel fuels. Other economic considerations include increased cost of fuel storage, increased cost of installation, lower heating value per charge which must be compensated for by engine changes, lower fuel cost, and a decrease in maintenance and oil costs.

Examples given showed a cost of $1.25 to $3.00 per gal of LPG stored for storage and service station facilities, while the cost of vehicle changes and installed equipment varied from $200 up for a passenger car or small truck to $900 or more for a bus. Compression ratio must be increased to

compensate for the lowered heating value per charge of LPG fuel-air mixture.

Not all engines have demonstrated that they are capable of increase in efficiency sufficient to compensate for this deficiency of the fuel and lower mileage has resulted. For purposes of comparison, a 5% loss in mileage was quoted as a reasonable figure. The savings in maintenance and oil costs are a function of their relative magnitude, but a range of from 50 to 200% seems to be indicated. It was pointed out, however, that maintenance costs may increase with LPG if the engine does not have reserve capacity to withstand the higher compression ratio.

The question of safety must be considered also. Properly handled by trained personnel, LPG is as safe as any fuel; but, because of its high pressure system and vapor state under atmospheric conditions, it is inherently less safe than the usual liquid fuels. This has been recognized by various regulating authorities and insuring agencies with increasing severity of control regarding storage, transportation, and use of the LPG fuel.

Spectroscope Pinpoints Worn Parts

• Mohawk-Hudson Group

Knud Antonsen, Field Editor

Feb. 2—"The spectrograph can indicate when not to spend money on overhauls as well as when to save money through preventive maintenance," concluded **Harold Sennstrom**, executive engineer of American Locomotive Co., in a paper on "Spectroscopic Inspection of Lubricating Oil."

Maintenance of diesel engines in locomotive service has so far been determined mostly by poorest performance of various parts. This often resulted in the unnecessary expenditure of much effort, examining components not yet due for replacement. Maintenance people, however, frequently attempt to increase the time between periodic inspections. Parts failure causing serious engine damage often results.

That is where the spectroscope serves as a means of determining the condition of the various critical engine components without resorting to frequent engine inspections.

The analysis of lubrication oil, of which samples are taken from the engine crankcase, determine how much metal, in number of parts per million (ppm), is present in the oil. As the components wear, minute particles of metal will accumulate in the oil. An increasing number of particles thus indicates excessive wear on certain parts.

Sennstrom then described the results of a widespread program conducted by American Locomotive Co. over a period of 12 months and in-

volving analysis of 12,000 samples. These were taken from 1500 locomotives. The engines in question were Alco's 12 and 16 cylinder, $8 \times 10\frac{1}{2}$ in., model 244 engines. To evaluate engine conditions, a minimum of six elements are determined spectroscopically. These are: iron, lead, copper, chromium, aluminum, and silicon.

Lead represents 90 to 95% of the lead-tin overlay of the main bearings. The intermediate layer is copper-lead. Thus the presence of these two elements in the crankcase oil will give indications of the magnitude of bearing wear.

Presence of iron can indicate wear of piston rings, crankshaft journals, gears and so on, but often combinations of elements have to be looked for to detect the source of iron.

Chromium can indicate cylinder distress since the liners are chromium-plated. However, it can also indicate water leaks, since the cooling water used is treated with chromates.

Aluminum comes from the aluminum pistons, and will thus indicate wear and scoring of these parts.

Silicon is the best indicator of dirt, particularly airborne dirt.

Laboratory tests have resulted in the establishment of base lines for the six indicating elements found in crankcase oils from normally functioning locomotive engines. These are: lead, 10 ppm; silicon, 6 ppm; iron, 20 ppm; chromium, 5 ppm; aluminum, 3 ppm; and copper, 4 ppm.

Sennstrom illustrated his talk with slides, showing case histories of individual locomotive engines. In describing these, it was made clear that the spectrograph may lead to more rational engine maintenance scheduling, taking into account the condition of each individual engine rather than the condition implied by experience of the poorest performance.

Before the meeting Robert Cass, president of SAE for 1953, was introduced to the group. Cass presented a short address in which he pointed to the necessity of the engineers becoming part of management. The materials situation, concerning nickel in particular, but also the growth of fields in which aluminum is being used, was commented on by Cass.

Don Blanchard, manager of the SAE Technical Committee Division, accompanied Cass on his visit and gave a brief talk on the work being done at SAE headquarters. Also present was E. G. Haven, newly elected vice-president of SAE representing Aircraft Powerplant Activity.

Coming: Cooler Cars

• Cincinnati Section

Edward B. Lohaus, Field Editor

Jan. 26—The outlook for cooler motoring was discussed by **Leon L. Kuempel** of Keco Industries in a paper on


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"Trends in Automotive Air Conditioning."

Increased public interest, plus developments in conditioning units, make the outlook promising, Kuempel said. Motorists are showing willingness to pay the prices necessary for effective units—and the increased volume will act to bring prices down and further broaden the market.

In some respects, the cars of today are hard to cool, Kuempel said. "We formerly had composite bodies that were easy to insulate and that were relatively air tight. We had only half as much glass area. We had a lot of room under the hood, and plenty of head room." But the trend towards soundproof insulation and away from freely ventilated bodies is making things easier, while sun visors and heat absorbing glass are counteracting the large glass area of the modern car.

Tells of Uses Of Guided Missiles

• Washington Section

Allen P. Blade, Field Editor

Jan. 20—**Dr. Walter A. Good**, an expert on servo-mechanisms of the Applied Physics Laboratory at Johns Hopkins University, explained and illustrated with movies the importance of guided missiles as a defense against air attack. The Section and guests were privileged with a most interesting and educational discussion of the necessity for and functions of guided missiles.

A brief history of guided missiles in the U.S.A. and other countries was presented showing that the guided missile dates back to 1916, with particularly fascinating developments in the past decade. A hypothetical anti-aircraft missile was described, highlighting the problems of supersonic aerodynamics, rocket propulsion and emphasis on servo-mechanisms. The several systems of missile guidance currently proposed were open to question and answer by the group.

Filmed experiments depicted the use of captured German V-2 rockets and the Aerobee rocket as high altitude platformers for upper-air research. Airborne cameras which peered down on the earth 70 miles below impressed the audience with a feeling of a short trip into near-space.

Dr. Good is the holder of the world's endurance record for radio controlled model airplanes. For three successive years he won the national radio control contest.

Unfortunately, Dr. Good's very interesting talk was in competition with the inaugural celebration. Chairman Jack Hulse expressed the appreciation of the Section for its rare opportunity to have enjoyed the expert presentation of missile guidance techniques and outlook for the systems.

Technical Committee Progress

Continued from Page 101

distortion. But in each case it's always necessary to check the end product in actual road tests.

By the same token, if an experimental brake exhibits lack of effectiveness, poor fade characteristics, rapid lining wear, permanent distortion, or scoring on field tests, such conditions can often be duplicated on a dynamometer and studied individually.

The brake dynamometer, then, is a most valuable piece of equipment for making many brake investigations. It provides the only logical approach to the selection of a new braking combination, subject of course to verification by road testing on the actual vehicle.

(Paper on which this abridgment is based, "Construction and Operation of Brake Testing Dynamometers" was presented at SAE Annual Meeting, Detroit, Jan. 13, 1953. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers. The paper also includes a copy of the new SAE Brake Dynamometer Test Code.)

New Format for Screw Thread Tables

ENGINEERS will be able to find the screw threads they want much more quickly and easily, thanks to the efforts of the SAE Screw Threads Committee. This group has spent over a year working out these changes, which have been approved by the SAE Technical Board. (The revised standard will be included in the 1953 SAE Handbook.)

Briefly, the revisions cover:

1. Unit presentation of text.
2. A new format for the tables.
3. Minor technical revisions to bring the standard into conformity with the latest revisions in the American Standard for Screw Threads.

In previous versions, the text was spread throughout the standard, with much of the material having to be repeated many times. Now all the material on a particular subject has been kept together, so that each subject needs to be dealt with but once.

The tables have been completely revised so that all threads of the standard series are grouped together for

each diameter-pitch combination. Similarly, all threads of special types are grouped together for each diameter-pitch combination. This method of tabulation should be much handier for the user, who is primarily interested in diameter-pitch combinations. Now he will be able to see at a glance all available possibilities for the particular diameter-pitch combination he is interested in. With the earlier standard he had to look at a half a dozen or more different tables to get all this information.

Tolerances and allowances have also been removed from the main tables and put in separate tables. Thus, the main tables now give only the basic dimensions.

Although the corresponding ASA Screw Threads Standard B1.1-1949 has not yet been set up in this way, steps are already being taken to revise them in accordance with the same principles.

It might be noted further that the format of the gaging standards is the same as that for the standard series of screw threads.

Round Head Bolt Standard Revised

THE SAE Standard for round, unslotted head bolts has been revised by the SAE Screw Threads Committee to conform with the recently issued American Standard (B-18.5-1952) for round head bolts.

Specifically, the revisions will make the SAE Standard conform with the American Standard, with two exceptions:

1. The body diameter of the bolt is held to a maximum that equals the nominal diameter, whereas the American Standard provides for two possible maximum body diameters (1) a body diameter held to a maximum that equals the nominal diameter and (2) a maximum body diameter that is a few thousands above the nominal figure. (This is true in all cases except for the round-head ribbed-neck bolt, where the maximum body diameter given by the ASA is allowed.)

2. It will not contain the standards for flathead, countersunk elevator bolts, ribbed-head—slotted and unslotted—elevator bolts, and T-head bolts to be found in B18.5.

Harold Fisher of Bendix, former vice-chairman of the SAE Screw Threads Committee, has been named chairman, replacing R. G. Cummings of Ford, who resigned. Vice-chairman is R. F. Holmes of AC Spark Plug.

The changes in the SAE Standard, which have been approved by the Technical Board, will be included in the 1953 SAE Handbook.

New Members Qualified

These applicants qualified for admission to the Society between Jan. 10, 1953 and Feb. 10, 1953. Grades of membership are: (M) Member; (A) Associate; (J) Junior; (SM) Service Member; (FM) Foreign Member.

Atlanta Group

Wallace Asbury Hanson, Jr. (J).

Baltimore Section

Paul Harry Cromwell (M).

British Columbia Section

Hugh Coleopy (J), Clifford E. Leon (M).

Buffalo Section

Melvin Lawrence Armbruster (J), Eugene Anthony Czeck (J), Frederick J. Kneisler (J), William F. Milliken, Jr. (M).

Canadian Section

Bruce R. Aubin (J), Eugene Canby (J), Ernest R. Gifford (A), Michael Owen Jones (J), C. R. Matthews (A), John Hideo Miura (M), John C. Muirhead (J), Thomas Melville Patterson (J), Morris Conroy Shonfield (A), Lester Gray White (A), Donald Winans (A).

Central Illinois Section

Richard B. Curry (J), Floyd S. Dadds (J), L. Burton Greer (M), William H. Neptun (M), Louis J. Templin (M).

Chicago Section

Charles M. Atterbury (A), G. Peter Blom (J), Dale L. Brott (M), Simon K. Chen (J), William Courtney Files (M), Harold A. Grenert (M), Fred Willard Haney, Jr. (J), David Lloyd Hanson (A), Irwin Jacobson (J), Martin E. Keane (J), Ralph E. Lambrecht (J), Richard George Moen (J), Leonard W. Okon (J), George R. Ondeck, Jr. (J), Howard L. Philippe (J), Robert W. Powell (M), Peter Francis Rath (J), Robert J. Schroeder (M), Leslie S. Tutty (A), Richard Graham Walsh (M).

Cincinnati Section

Peter W. Dwyer (J), Vernon T. Nugent (A), Michael J. Tomich (J), Ralph W. Woods (J).

Cleveland Section

Reuben C. Carlson (M), Elias L. Corpas (J), Stanley Park Funkhouser (J), Clifford E. Heidenreich (M), David L. Kerr (J), William W. Kirk (M), Maurice E. Kline (A), Paul H. Kramer (J), Roy A. McKinnon (J), Rudolph Joseph Menart (M), Charles L. Moon (J), Jerry R. Mrlik (J), Willard W. Nelson (A), Nicholas Olek (A), George M. Perry (M), Clarence L. Playford (M), Edward John Ratkay (J), David E. Reyna (J), Albert P. Rogel (J), Herbert E. Sietman (M), Walter Martin Waldbauer (J), Louis C. Wolff (A).

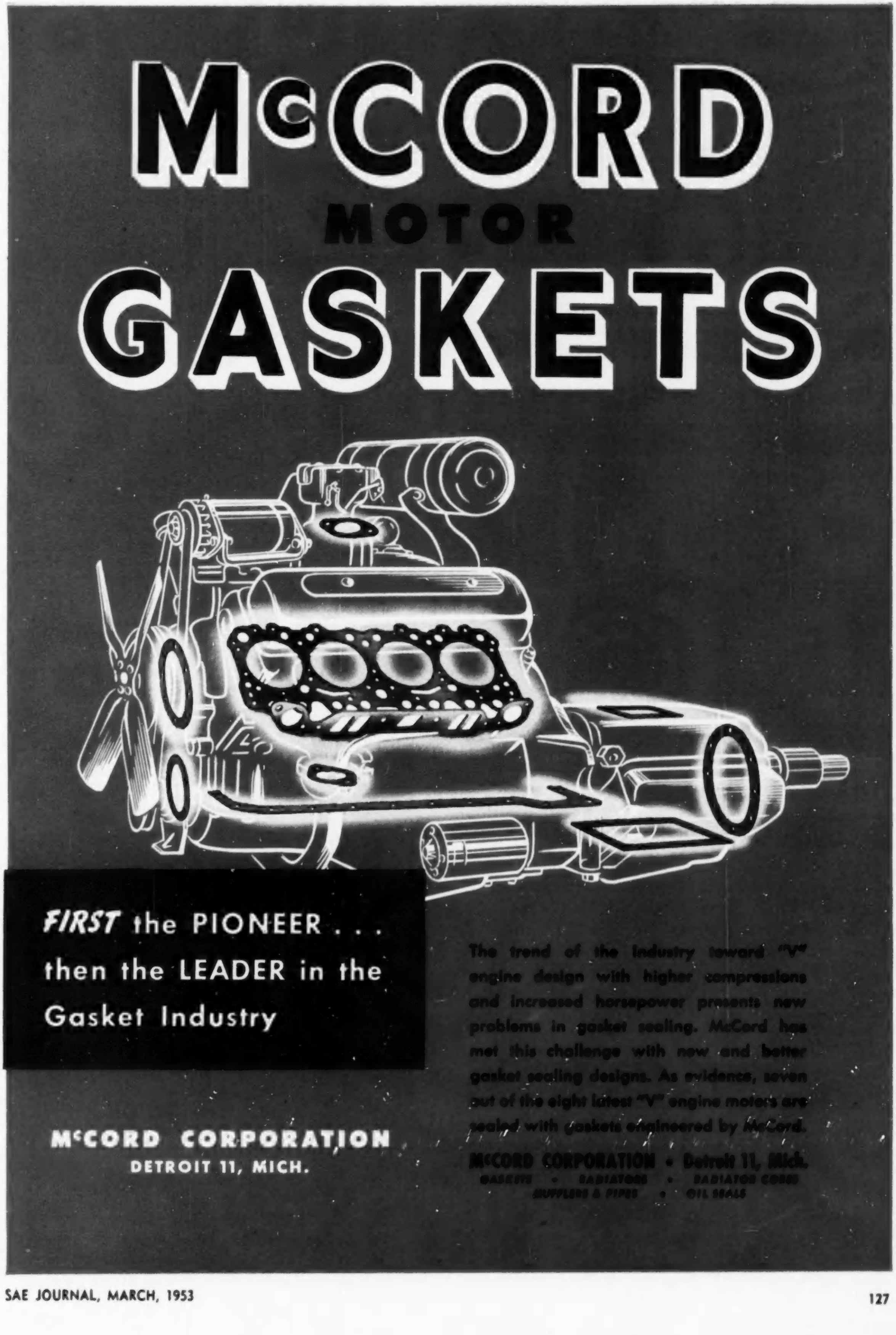
Dayton Section

Harold C. Mott (J), Paris C. Paraskos (J).

Detroit Section

Lee Harrison Allen (J), Donald E. Bowen (J), Phillip C. Bowser (J), John H. Cauley (A), Gerald Robert Checkley (J), Victor S. Cochoff (J), Clyde Carl Culver (J), Carle F. Cziske (A), Fred Robert Dietrich (J), Robert J. Dika (M), Charles Leslie Dittoe (J), Robert N. Frantz (M), Harvey W. Frye (A), Emilio Gabriel (J), Lester C. Gates (M), Joseph Peter Gietzen (J), Joseph Raymond Gillette (M), George T. Gorman (A), Harold P. Henning (M), Walter L. Hill (J), Jack Donald Hinton (M), Emerson Mansfield Hough (M), Willman E. Jackson

Continued on Page 128


McCORD
MOTOR
GASKETS
FIRST the PIONEER . . . then the LEADER in the Gasket Industry
McCORD CORPORATION
DETROIT 11, MICH.
The trend of the industry toward "V" engine design with higher compressions and increased horsepower presents new problems in gasket sealing. McCord has met this challenge with new and better gasket sealing designs. As evidence, seven out of the eight latest "V" engine motors are sealed with gaskets engineered by McCord.
McCORD CORPORATION • Detroit 11, Mich.
GASKETS • RADIATORS • RADIATOR CORES
MUFFLERS & PIPES • OIL SEALS

New Members Qualified

Continued

(J), John J. Jarvie (M), Robert P. Jensen (J), Robert Frank Jenson (J), Gordon K. Jones (A), Michael Johnson, Jr. (M), Raymond Jozefowicz (J), Richard Kramer Kepple (J), Richard L. Kieft (J), Robert O. Kindt (J), Henry James Kozicki (M), Walter James Laita, Jr. (J), Glenn Laing (J), Allen M. Kushner (J), Gordon J. Kuivanen (J), John Edwin Marlow (J), Siragan Marderosian (J), Carel Johan Frans Mali (M), Ralph A. Meyering (J), Edwin L. Miller (M), William A. Niffin (J), Oscar B. Noren (M), Charles A. Peterson (A), John C. Rau (M), Mario Revelli (M), Walter Edward Rogers (M), Clinton Malcolm Rose (J), Frank Rosiek (J), Charles L. W. Seith (A), Henry J. Tamagne (J), Anthony Tomac (J), Robert Edward Tyner (J), John D. M. Velte (J), Roger W. Wassman (J), Lee S. Wright (J).

Hawaii Section

W. W. Miller (A), Herman W. Sivley (M).

Indiana Section

Werner W. Berger (J), Bruce C. Center (J), Richard Thomas Clark (M), Henry A. Geisler (M), Francis Anthony Urbaniak (J), George L. Webb (M), Michael Zoretich, Jr. (J).

Kansas City Section

A. M. Cole (M), Donald Everett Flick (M), Merlin D. Howard (J), Davon Bland Pierce (J), Paul Edward Tomshany (J), Marvin D. Vawter (M).

Metropolitan Section

David Albin Anderton (A), Frank R. Cassel (SM), Leao Goncalves De Oliveira (J), John J. Duzich (J), Morton S. Feinsilver (J), John Flannery, Jr. (M), Robert Henry Fritzges (M), Walter Joseph Handlen (J), Stefan J. Harvey (M), Richard W. Heidersberger (J), Ivar F. Larsson (J), Joseph R. Levitt (M), Peter G. Nicholas (J), John J. Pietruszkiewicz (A), Robert John Service (J), Homer U. Tsakis (J).

Mid-Continent Section

William R. Bohannan (J), Richard Arthur Mengelkamp (M).

Mid-Michigan Section

Robert J. Ferguson (J), Howard F. McColly (M), Raymond Joseph Schultz (J), Eldon Williard Tibbits (J), Anthony Waydak (M), Guy W. Wesson (J).

Milwaukee Section

Robert P. Bekke (A), Rodney Owen Berger (J), Leslie A. Cantley (M), Gerald Joseph Kuchera (J), John Everette Langdon (J), Kenneth A. McLyman (M), Robert Elden Niva (J), Merle H. Peterson (M), Francis H. Tennis (M).

Montreal Section

Edward William Baker (M), Charles A. Dinsmore (A), Georges Donato (J), John McNeill (J), Jan Murer (J).

New England Section

Wilbur Edmund Bassett (J), Ross Stuart Karlson (J), Russell Leonard Lawson (J), Hans Ulrich Wydler (J).

Northern California Section

Lyle O. Bowman (J), W. A. Knuckey (M), Donald A. Murray (J), Orrin Mitchell Prouty, Jr. (A), Edward Hall

Continued on Page 130

New Members Qualified

Continued

Rayermann (J), John M. Smith (M), Jess Virgil Terry (A), Dennis James Treadway (M).

Northwest Section

S. M. Baunsgard (A), William F. Driver (M), Earl C. Reed (J).

Oregon Section

William C. Kieling (J), Leonard W. Peoples (J), Ned Ransom Powley, II (M).

Philadelphia Section

Vincent E. Di Lucia (M), C. Clark Kenlan (M), John Albert Lamb (J), Alden J. Pahnke (J), William Virgil Rich (M), John J. Sheehan (M), Gordon Walter Woods (J).

Pittsburgh Section

Robert F. Demmler (J), Donald E. Foringer (J), John Charles Konkler (J), Joseph B. Lasky (M), William J. Masters (J), William L. Mosenson (A), Howard N. Seese, Jr. (J).

St. Louis Section

Robert E. Coughenour (A).

San Diego Section

Merwyn O. Faiman (J), Jack M. Palmer (M), Carl W. Pieper (J), Andrew Segal (J).

Southern Calfornia Section

Charles T. Aubrey (M), Arthur R. Beckington (J), Eugene Norman Borson (J), Selby W. Brewer (M), Walter K. Deacon (M), Jean Clail DuBuisson (J), Robert E. Frederickson (M), Frank S. Gadomski, Jr. (J), Preston George Holland (J), O. Allen Knuusi (M), Andrew Michael Krawicz (J), S. Richard Krown (J), Oronzo L. Linsalato (J), Edwin I. Mosher, Jr. (J), Satoshi Nitta (J), Robert Allen Ross (J), Michael M. Schuster (J), Jesse R. Smith (J), William Robert Walker (J), Edward James Whitney (J), Norman Eugene Wood (J), Robert Joseph Von Flue (J).

Southern New England Section

Frank Lindy Buscarello (J), Albert Claude Ching (J), Henry A. Dyson (J), John Rogers Hansen (J), Stanley J. Krol (J), Carl W. Lemmerman (M), Charles J. Peterson (M), Raymond A. Swanson (M), Robert Elwood Thornton (J).

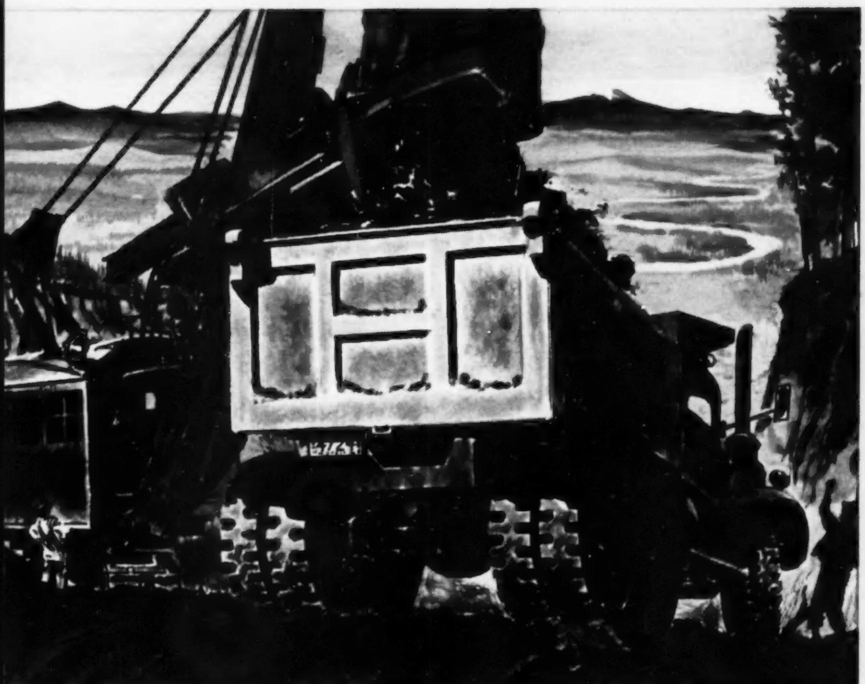
Spokane Intermountain Section

John R. Bonner (A), Robert H.

Continued on Page 133

Tandem-Drive Units

MOVE EXTRA-HEAVY LOADS OVER EXTRA-RUGGED TERRAIN

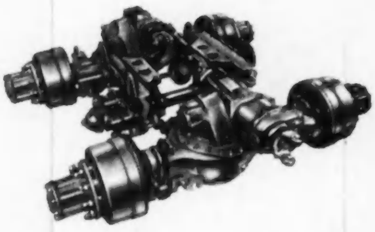


High-Powered Engines Can Be Used to Full Advantage!

TDA makes it possible to move the heaviest type of loads through rough off-highway terrain. In such fields as logging, mining or construction, where trucks must move miles over temporary roads to and from jobs, TDA Tandem-Drive Units provide the needed strength and pulling power.

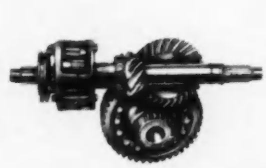
These heavy-duty axle units take full advantage of high-powered engines, resulting in greater tractive ability and lower operating costs. TDA Tandem-Drive Units provide truckers with many other important advantages, too. For instance, the axles are always kept correctly spaced and aligned by means of a parallelogram suspension of the torque rods. This eliminates the possibility of weight transfer.

Since tandem-drive units first came into use more than 30 years ago, Timken-Detroit has led the trucking field in their design and manufacture. Designed and built in their entirety by TDA, these rugged tandems have been used in practically every type of hook-up for tandem rear axles in this country and abroad, under every make of six-wheel truck. Therefore, the TDA design of tandem-drive units reflects this 30-year record of engineering and manufacturing leadership. Write to Timken-Detroit today for the interesting story of Six-Wheelers and TDA Tandem-Drive Units.



HEAVY-DUTY TANDEM WITH DOUBLE-REDUCTION DRIVE

Available with either through drive or inter-axle differential, these rugged units are especially adaptable for off-highway use. They move mammoth loads with ease regardless of terrain. Powerful TDA Brakes assure positive vehicle speed control at all times.



DOUBLE-REDUCTION FINAL DRIVE WITH INTER-AXLE DIFFERENTIAL

This double-reduction final drive, has rugged, time-proven Hypoid gearing in the first reduction. The slower gear ratios practical with this type of final drive make it especially adaptable to high-powered engines—an important feature in off-highway operation.

The Accepted Standard

AXLES

THE TIMKEN-DETROIT AXLE COMPANY

Detroit 32, Michigan

WORLD'S LARGEST MANUFACTURER OF AXLES FOR TRUCKS, BUSES AND TRAILERS

PLANTS AT: DETROIT AND JACKSON, MICH. • OSHKOSH, WIS. • UTICA, N.Y. • ASHTABULA, KENTON AND NEWARK, OHIO • NEW CASTLE, PA.

The best-engineered trailer axles on the road come from Timken-Detroit!

This modern manufacturing plant, located at Kenton, Ohio, houses the Trailer Axle Division of The Timken-Detroit Axle Company.

Timken-Detroit *knows* trailer axles! More than 40 years' experience in building axles for trucks, buses and trailers attest to that! Furthermore, nine great plants—one of which is devoted to developing and producing trailer axles—are provided with every modern engineering, research and production facility. Highly trained technicians are constantly at work improving the materials, design and workmanship that go into every trailer axle produced by Timken-Detroit. Months, and often years, are spent in developing and testing axles before they ever leave the blueprint stage. In the trailer axle field, too, Timken-Detroit knows its business!

WORLD'S LARGEST MANUFACTURER OF AXLES FOR TRUCKS, BUSES AND TRAILERS

PLANTS AT:
DETROIT AND JACKSON, MICH. • OSHKOSH, WIS. • UTICA, N. Y.
ASHTABULA, KENTON AND NEWARK, OHIO • NEW CASTLE, PA.

The Accepted Standard

D T A CO®

AXLES

THE TIMKEN-DETROIT AXLE COMPANY
Detroit 32, Michigan

New Members Qualified

Continued

Briscoe (M), J. G. Critzer (A), John Joseph Zajac (J).

Syracuse Section

Clarence J. Hornbeck (J).

Texas Section

Richard Frank Burris (M), Julian E. Gerry (M), Robert Max Hooks (J), Glen W. Putney (J), G. B. Shandley (A), David C. Spraker (J), H. Patrick Warren (M), 1st Lt. James Pruett Whitman (J).

Twin City Section

Don O. Benson (M), Irvin C. Beuthling (M), Joseph H. BeVier (A), Robert De Ghetto (J), Dale W. McKee (M), Quentin I. Wilcox (M).

Virginia Section

James Alfred Beckett (M).

Washington Section

Francis Edward Butler (J), Robert J. Gordon (A), Joseph A. Smith (J), Daniel Stern (J).

Western Michigan Section

Stanley J. Bourdon, Jr. (J), Howard B. Yarbrough (M).

Outside Section Territory

Frederick George Baily (J), Richard Thomas Gainey (J), Ralph John Gimera (J), Robert S. Jacobus (J), Charles G. Moore, Jr. (J), James Floyd Pope (J), Charles R. Remington, Jr. (M), John P. Sandoval (M), David Schafale (M), Roy F. Schwegler (M), Allan Richard Smith (J), Robert C. Souers (J), Richard Willard Straw, Sr. (J), Charles H. Sweatt (M), Lt. (JG) Richard A. Wester (J).

Foreign

James Walter Agnew Andrews (A), England; James Maskell (J), England; Amilcare Porro (FM), Italy.

Canadian Section

Alan Wells Bennett, Willard O. Burgoon, William Edmond Moore.

Central Illinois Section

Oscar S. Beckham, Jr., Max Edward Butterfield, Joseph H. Dolan, Richard M. Edwards, Howard W. Huette, Joseph E. Jakoby, Joseph G. Klecker, Russell W. Larson, Ray R. Laughlin, John H. Parks, William L. Sprick, Floyd J. Wingert.

Chicago Section

Ernest Ray Cunningham, Jr., Louis M. Gray, Sr., Nicholas J. Hughes, Frank Iwatsuki, Ernest J. Mehochko, Leopold P. Josephs, C. W. Leslie, Paul B. Miller, J. N. North, Warren K. North, P. L. Reynolds, Walter J. Zwierzycki, Leonard C. Nelson.

Cleveland Section

Leland Condit, Charles C. Dick,

Continued on Page 134

Applications Received

The applications for membership received between Jan. 10, 1953 and Feb. 10, 1953 are listed below.

British Columbia Section

John Alexander McPhee.

Applications Received

Continued

Frank J. DiNatale, Elizabeth A. Fathauer, Gerald D. Griffin, John D. Hanks, Philip Hermann, Henry H. Homitz, Charles W. Howard, Melvin P. Prasse, Kenneth Leonard Selby, Forrest E. Smith, Harold R. Sobeck.

Colorado Group

William J. Holtman.

Dayton Section

C. M. Allen, Helge M. Evensen.

Detroit Section

Robert B. Alexander, Peter Chatfield Ball, Ralph R. Bekkala, George A. Berry, LaVerne R. Biasell, William Harper Bickerstaff, Harry A. Bolenski, George E. Brown, Frederick J. Burke, Harry M. Casebeer, John Gerald Champine, Donald E. Cox, R. Lawrence Crosier, James E. DeRemer, Richard C. Devereaux, Robert L. Erwin, Floyd Fair, Paul W. Fair, John J. FitzGerald, Jr., Maurice E. Fordyce, Harold Sidney Freidman, Rollin R. Galloway, Peter A. Goudreau, Raymond Gregorich, Robert Lewis Hauser, Thomas E. Hustead, Walter Robert Irving, Lewis Francis Jilbert, Richard S. Karbowski, James C. Kaufeld, Robert E. Kraemer, Lester S. Ludwig, Fred Lyijynen, Andrew B. MacIsaac, O. Martens, John F. McCarthy, Edwin John McCauley, Otto Morton Nedved, Russell R. Noble, Clayton J. Pajot, Louis B. Peltier, Jr., Andrew J. Pepper, Charles R. Petoskey, Richard F. Reichmuth, Jesse W. Richards, Richard Bruce Ruokolainen, Herbert L. Sanborn, Jorma O. Sarto, Alfred Bruce Sauer, John F. Scarpelli, William D. Shanks, Robert H. Stridiron, Charles Edward Terrill, Steve J. Trukalo, William J. Ulrich, Thomas D. Weiser, Frederick G. White, Jr., Norman C. Wilson, Parke Woodworth, Raymond J. Wrobel, Robert W. Zander, Norman E. Zerndt, Leonard O. Zick.

Hawaii Section

Fred K. Cordes, Robert Louis Linder, Robert K. McGill.

Indiana Section

Paul B. Budai, Jr., Herman James Redd, Louis R. Russell, William V. Ryan.

Kansas City Section

John W. Lynch.

Metropolitan Section

James Ernest Davis, Raymond M. Ferris, Russell C. Grube, Carl V. Julien, Joseph J. Mancusi, Jr., Robert S. Mullaney, Helmer Peterson, James Richmond-Crum, Warren E. Ring, Gerald S. Rothman, Gary Schleimer, James J. Scott, James L. Smith.

Mid-Continent Section

Harold G. Everett.

Mid-Michigan Section

Roy L. Bowers, Arthur Charlesworth, Homer Russell Hastings, Ralph M. Howes, Lyman M. Lamoreaux, Ralph R. McClintock, Henry Charles Stuerzl, William Blair Thompson, Roy S. Thornburgh, Kenneth E. Tribell, Joseph J. Verbrugge.

Milwaukee Section

William Francis Elliott, Gerald E. Gilbertson, Edward A. Kubicek, Verne W. Nichols, Donald H. Paul, Aristotle Paras, Raymond E. Paul, Thomas J. Radlet, Robert L. Trapp, James E. Vetter.

Continued on Page 137

Applications Received

Continued

Mohawk-Hudson Group

Alan Lee Williamson.

Montreal Section

Georges L. Archambault, Hugh Graham Brown, B. Gordon Glass, David Greenhill, Leslie H. Kottmeier, Roland Lesperance, Walter P. MacGillivray, Jimmy Mair, William Grey Scherk.

New England Section

Theodore F. Andren, Fred Joseph Croce, David I. Driscoll, Charles Fredrick Koopman, Jr., Vance Phillips, Edward Shuh.

Northern California Section

Roland F. Gergstrom, F. A. M. Buck, William F. Halloway, Leonard Gordon Keating, Ensign David Walter Knoll, John F. Koehnle, Harry W. Nevin, Jr., Charles Keith Parker, Jr., Jay C. Paterson, Marcus W. Savage.

Northwest Section

Edwin R. Strohm.

Oregon Section

Milton E. Winters.

Philadelphia Section

Christian W. Goll, F. Edgar Pelly, Thomas L. Scatchard, Earl A. Smith, Jr., Warren E. Young.

Pittsburgh Section

Robert Miller Kuhn, H. G. Cranston.

St. Louis Section

Gerald C. Dannan.

San Diego Section

Gabriel C. Danch, Richard Teller.

Southern California Section

James Andrews Broadston, Frances Gaba Gorman, R. R. Heideman, Karl Lindberg, Fred T. Miller, Albert Bracewell Seed, Leland Richard Wylie.

Southern New England Section

A. J. Curello, Claude F. Waldron, Sr.

Syracuse Section

Donald G. Ritchie.

Texas Section

Jesse T. Crafton, Edward J. Sears, Robert A. Stevens, Robert L. Wallace, Benjamin F. White.

Twin City Section

George W. Balch, Jack Kleinberg, Louis J. Pauly.

Washington Section

James Thomas DiPiazza, Major Kidar Nath Koshal.

Western Michigan Section

Albert A. Carlson, Lawrence H. Workman.

Wichita Section

Russell Emmett Fahey.

Outside of Section Territory

George Bohn, Jr., A. Jean Boissonnas, Vincent A. Butler, David R. Ferria, Albert W. Foster, Stanley John Frith, Samuel Gadeski, Alphonse A. Jacobellis, Joseph Sharpe.

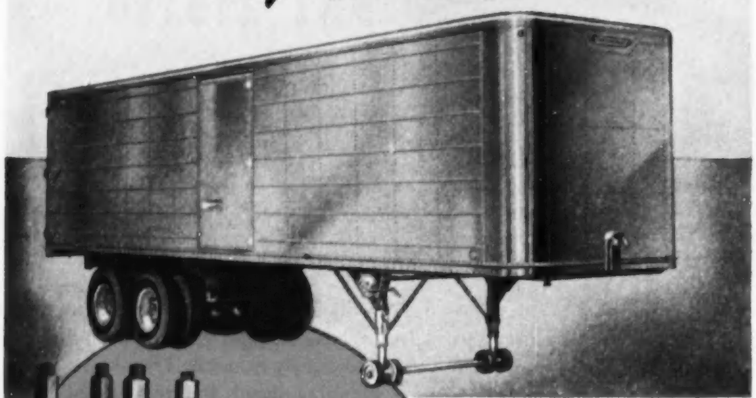
Foreign

Yoshie Akiba, Japan; Geoffrey Robert Greenbergh Gates, England; Willy Huter, Switzerland; Royston Charles Lunn, England; Victor Stanley Porter, England; William Rankin, Scotland; Arthur St. John Mitchell, England; Robert James Herbert Soanes, England; Eugene Stump, Germany; Sven-Olof Svantesson, Sweden.


YOU'LL NEVER FIND
a trout in hot water
This finny fellow likes his water fast and icy cold. With courage to spare, he charges up the swiftly moving stream, never faltering, timing his leaps and acrobatic flips. No doubt about destination with him.
When building a new product, many companies, our customers included, head straight up stream on a planning venture . . . their goal clearly in mind. They know full well the value of planning ahead. By investigating the use of castings in place of more costly machined parts, they frequently come up with improvements that pace their industries. Castings produced by Campbell, Wyant and Cannon, give them greater flexibility of design, better machinability and more resistance to wear at lower cost.
Why not get in the swim of things? Let CWC castings do a real job and maybe you'll have time to cast a fly at the worthy trout.
CAMPBELL, WYANT AND CANNON
FOUNDRY COMPANY
Muskegon, Michigan
CWC
Since 1908

TRAILMOBILE

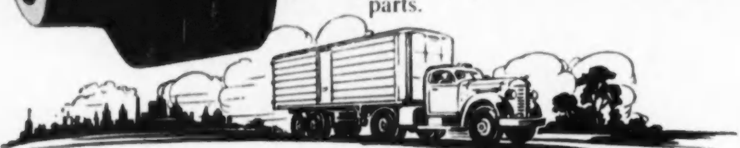
RADIUS ROD JOINTS by LORD



Look at the Trailmobile radius rod joint shown in close-up at the left. This Lord high performance center-bonded-rubber joint .....

1. Saves manufacturing and maintenance cost,
2. Absorbs the shocks of braking-loads and road irregularities imposed on the radius rods,
3. Provides necessary articulation.

When axle inspections require removal or replacement of radius rod joints, a simple arbor-press operation shortens loss of payload time and reduces actual repair cost. We invite you to avail yourself of our experience in designing and manufacturing precision bonded-rubber parts.



BURBANK, CALIFORNIA 233 South Third Street	DALLAS, TEXAS 413 Fidelity Union Life Building	PHILADELPHIA 7, PENNSYLVANIA 725 Widener Building	DAYTON 2, OHIO 410 West First Street
DETROIT 2, MICHIGAN 7310 Woodward Ave.	NEW YORK 16, NEW YORK 280 Madison Avenue	CHICAGO 11, ILLINOIS 520 N. Michigan Ave.	ERIE, PENNSYLVANIA 1635 West 12th Street

LORD MANUFACTURING COMPANY • ERIE, PA.

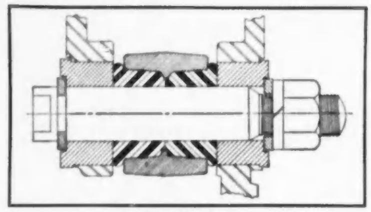
LORD BONDED RUBBER

Headquarters for **VIBRATION CONTROL**

ADVERTISEMENT

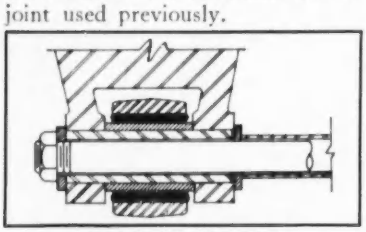
Lord Bonded Rubber Improves Radius Rod Joint on Trailmobile

Trailmobile, Inc. at Cincinnati, Ohio, believed that maintenance costs on their suspension systems could be reduced by redesign of the radius rod rubber bushings. When their standard radius rod had to be disconnected for maintenance of the suspension, often it was necessary to replace a number of parts of the radius rod rubber bushing assemblies.



Old Design

Lord engineers worked with the designers at Trailmobile to arrive at a rubber joint design that permits making an almost limitless number of disconnections of the radius rods without requiring replacements of the rubber joints, requiring only the time needed to remove the pin through the joint and bracket. The Lord Center-Bonded Joint, now standard in new Trailmobile assemblies, not only fully satisfied requirements, but did so with fewer and simpler parts, *and* at a cost lower than that of the unbonded rubber joint used previously.



Lord Design Now Used

Now when it becomes necessary to remove the Trailmobile Radius Rod it is a simple, easy operation to drive the pin from the hanger. When new bushings are necessary the old ones are pressed out and new ones installed with an arbor press.

Improvements of this nature are being designed into a wide diversity of automotive and industrial products as the result of cooperative efforts of Lord Engineers and the Design Engineers of such product manufacturers. Precision manufacture is the added ingredient which gives Lord Engineering its high value to industrial designers.

ADVERTISEMENT

Lord Bonded-Rubber Products Set Standard In Vibration and Shock Control For Over Twenty-Five Years

In the field of technical analysis and engineering to "design out" destructive factors set up in the machines of industry by vibration and shock, Lord Manufacturing Company continues to pioneer and set the pace for precision made vibration control mountings and bonded-rubber parts.

Years of experience in mounting aircraft engines and airframe components enable Lord Engineers to help industrial equipment designers in obtaining smoother operation, longer service life and increased safety in their machines.

Lord Engineers draw from some 27,000 basic designs and their variations to solve many vibration and shock problems referred to them by machine designers. Add to this the continuous research engineering available from the company's complete laboratories, and it becomes a matter of near impossibility to present a vibration problem which cannot find solution in the Lord Organization. The scope of Lord Design and Precision Manufacture covers Vibration Control Mountings for aircraft engines and components in both the internal combustion and jet field, delicately balanced and precisely assembled units of accounting machines, electronic equipment, instrument panel mountings, shipping case mountings for the protection of sensitive machines in transit.

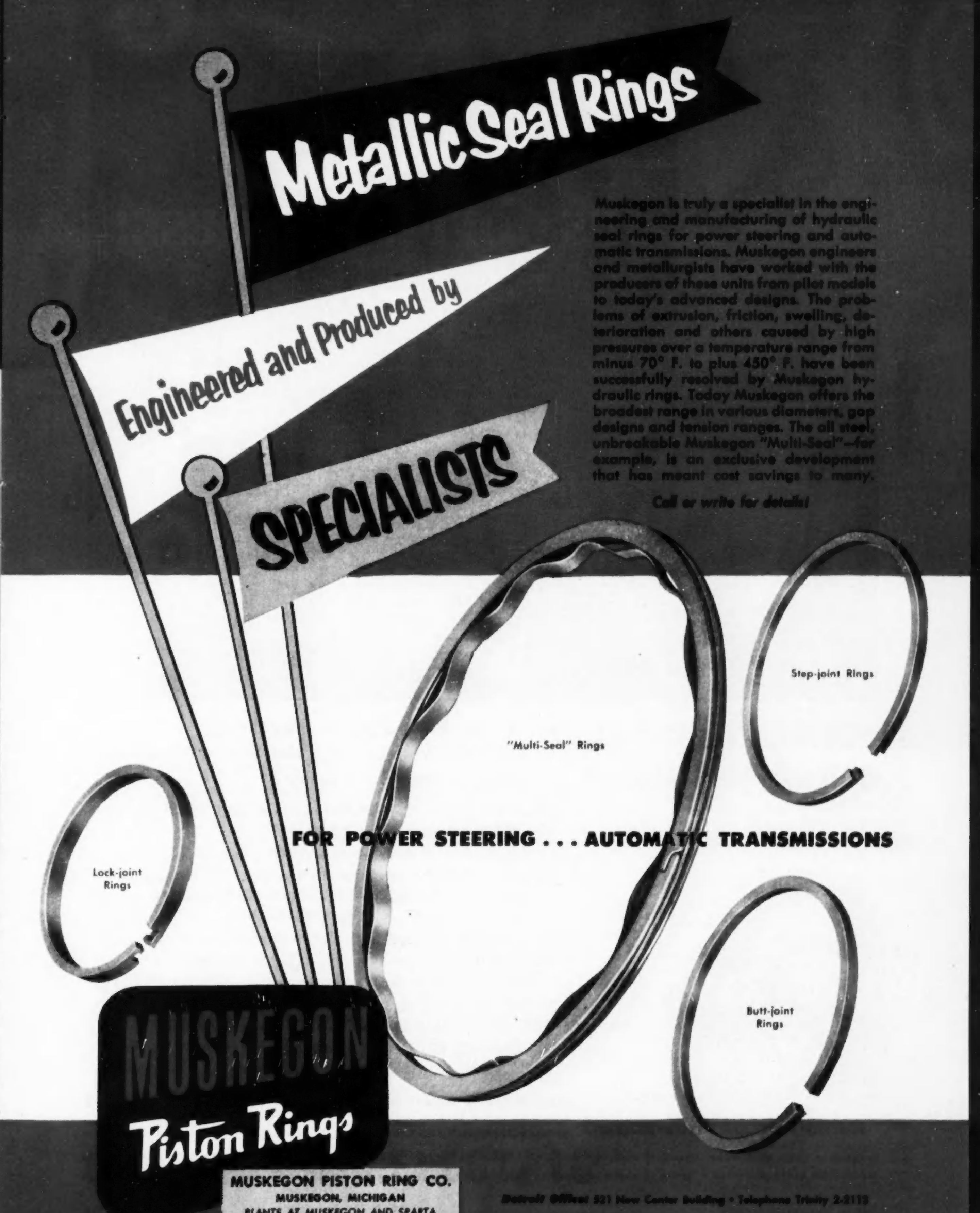
Designers of home appliances use Lord bonded-rubber parts for fanhubs, flexible couplings and special components for washing machines, room air conditioners, mixing and juicing devices. Lord Flexible Couplings are used in the mechanism which operates motorcar windows and convertible tops. The turbine engine for heavy duty motor truck transport, a recent development of the Boeing Airplane Company, is connected to the power transmission by a special Lord Flexible Coupling and the engine itself is supported on Lord Mounts. Lord Engineering and Precision Manufacturing facilities are available to business and industry wherever Vibration and Shock Isolation problems require a precise, accurate and inexpensive solution.

BURBANK, CALIFORNIA 233 South Third Street	**DALLAS, TEXAS** 413 Fidelity Union Life Building	**PHILADELPHIA 7, PENNSYLVANIA** 725 Widener Building	**DAYTON 2, OHIO** 410 West First Street
DETROIT 2, MICHIGAN 7310 Woodward Ave.	**NEW YORK 16, NEW YORK** 280 Madison Avenue	**CHICAGO 11, ILLINOIS** 520 N. Michigan Ave.	**ERIE, PENNSYLVANIA** 1635 West 12th Street

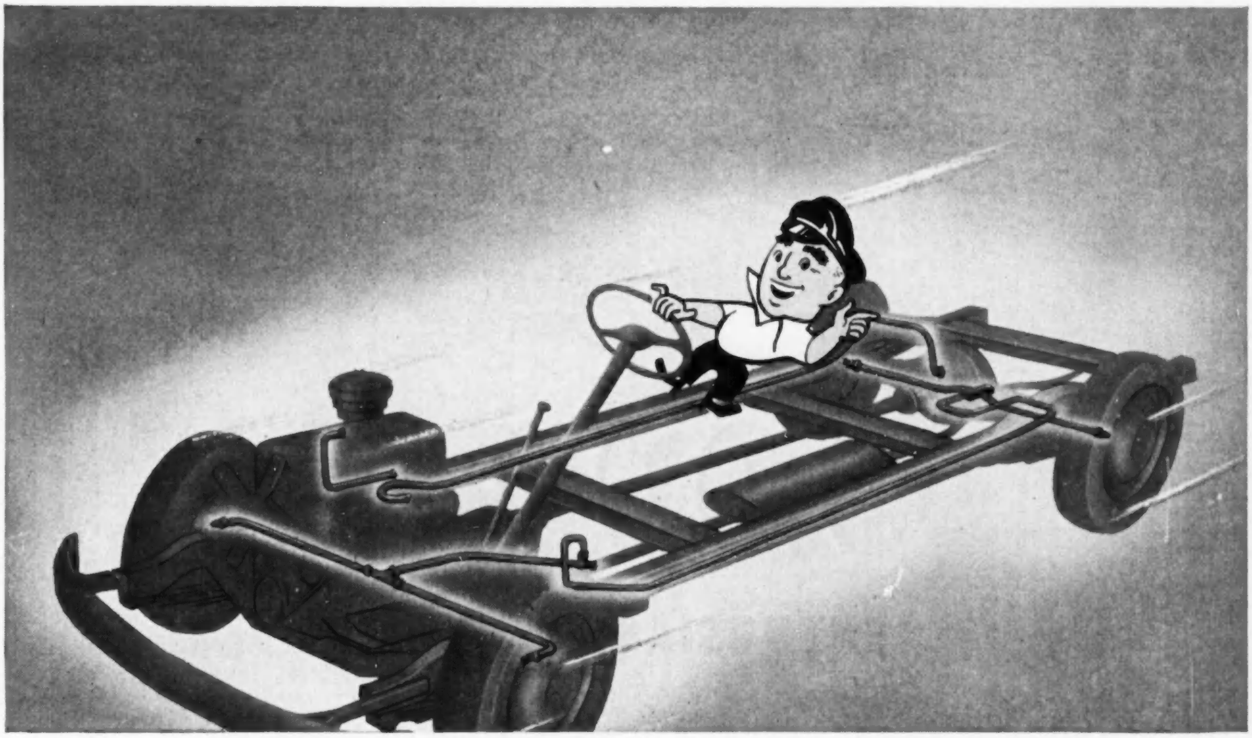
LORD MANUFACTURING COMPANY • ERIE, PA.

LORD BONDED RUBBER

Headquarters for **VIBRATION CONTROL**



Metallic Seal Rings
Engineered and Produced by
SPECIALISTS
Muskegon is truly a specialist in the engineering and manufacturing of hydraulic seal rings for power steering and automatic transmissions. Muskegon engineers and metallurgists have worked with the producers of these units from pilot models to today's advanced designs. The problems of extrusion, friction, swelling, deterioration and others caused by high pressures over a temperature range from minus 70° F. to plus 450° F. have been successfully resolved by Muskegon hydraulic rings. Today Muskegon offers the broadest range in various diameters, gap designs and tension ranges. The all steel, unbreakable Muskegon "Multi-Seal"—for example, is an exclusive development that has meant cost savings to many.
Call or write for details!
Step-joint Rings
"Multi-Seal" Rings
FOR POWER STEERING . . . AUTOMATIC TRANSMISSIONS
Lock-joint Rings
Butt-joint Rings
MUSKEGON
Piston Rings
MUSKEGON PISTON RING CO.
MUSKEGON, MICHIGAN
PLANTS AT MUSKEGON AND SPARTA
Detroit Office: 521 New Center Building • Telephone Trinity 2-2113



2 **Regardless** of the kind of vehicle you're concerned with, you'll gain new peace of mind —and much more—with Bundyweld in your gasoline, oil and hydraulic brake lines.

Safety and Bundyweld Tubing go hand in hand in the automotive industry.

That's been proved by the trouble-free performance of almost 500,000 miles of Bundyweld used in automotive tubing parts in the last twenty years. But you gain even more than safety when you use Bundyweld.

For instance, you get help from skilled tubing engineers who'll work with you to crack tough problems in design, fabrication, or function. As you work with our men, you'll see why we can recommend them as people who know their Bundyweld inside out and understand your problems, too.

You get the automotive industry's most up-to-date and versatile fabrication facilities working for you. This pays off in parts accurately produced at lowest possible cost, carefully inspected, properly packed for safe transport and economical handling, shipped to arrive exactly when you want them. If your plant's equipped for fabrication you can order Bundyweld in easily handled straight lengths, too.

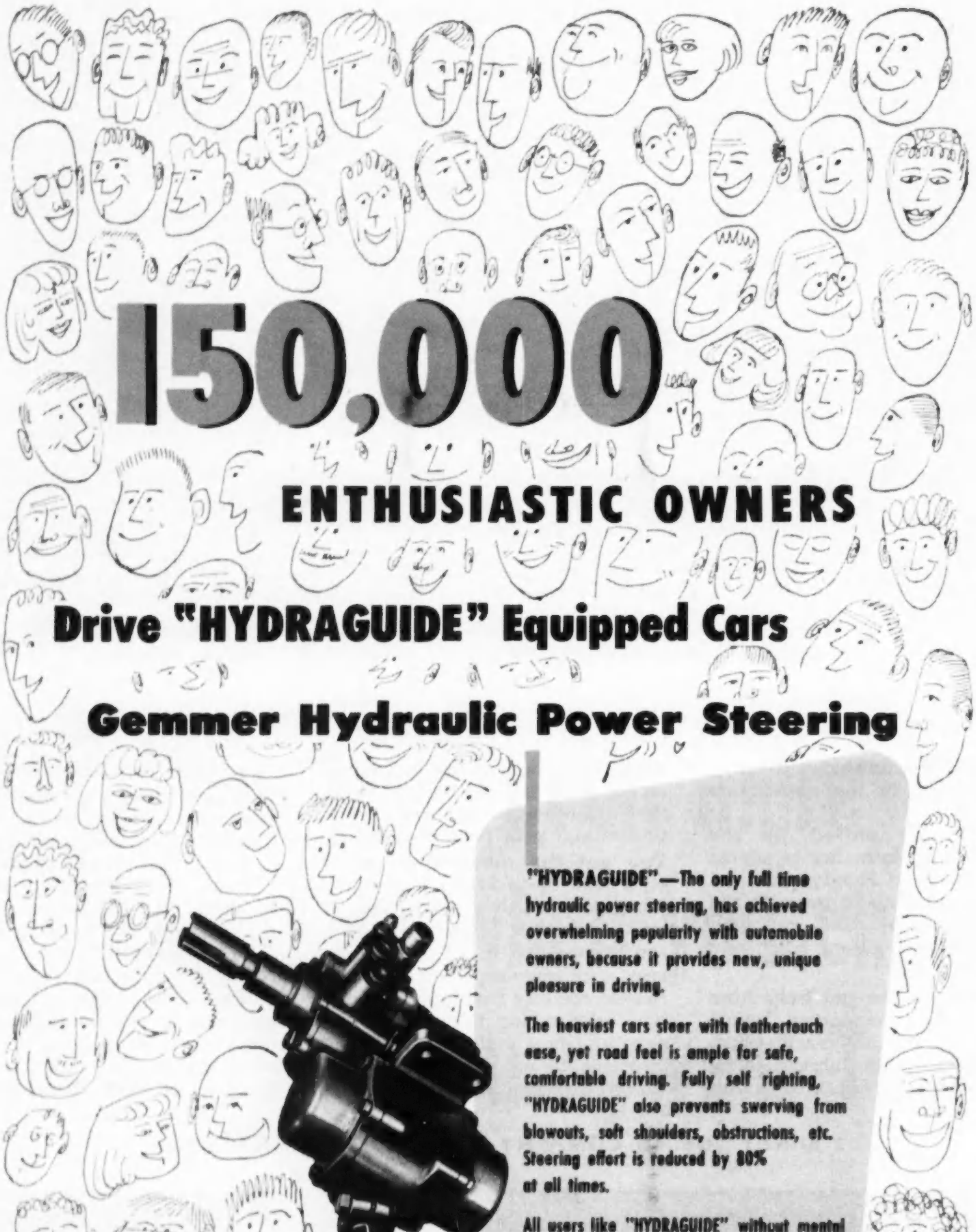
You get tubing properties no one's ever equaled. Bundyweld is the only tubing double-walled from a single strip, copper-brazed through 360° of wall contact. It's leakproof. It's lighter, yet stronger —withstands severe shocks and has high fatigue limit.

For tubing that's the standard of dependability in the automotive industry, for engineering help and fabrication facilities you can't beat, come to Bundy, world's largest producer of small-diameter tubing.

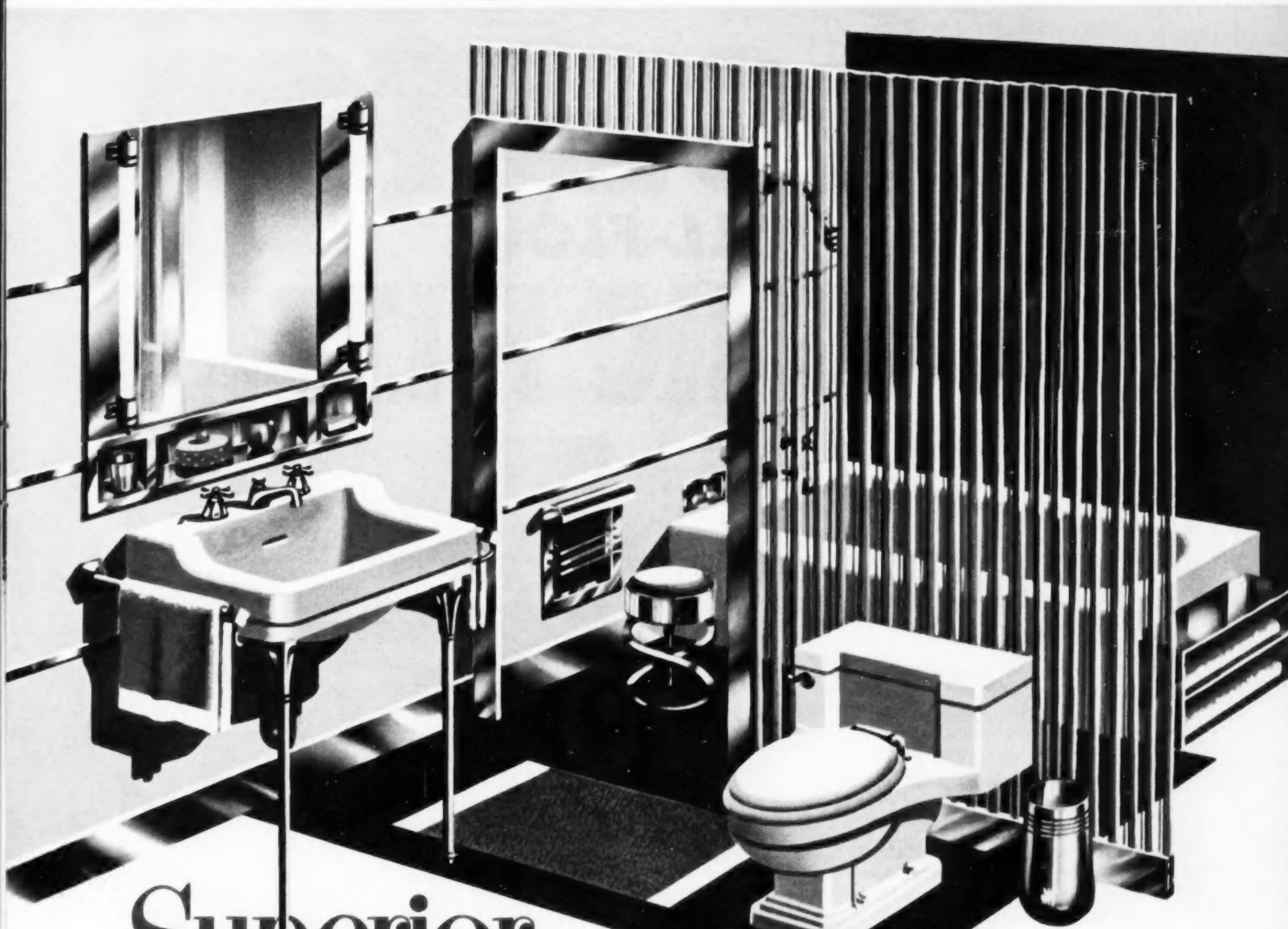
BUNDY TUBING COMPANY • DETROIT 14, MICHIGAN

Bundyweld Tubing®

DOUBLE-WALLED FROM A SINGLE STRIP



GEMMER MANUFACTURING COMPANY • Detroit 11, Mich.



Why the leaders prefer

PUROLATOR

FULL-FLOW

MICRONIC FILTERS

✓ **Full-flow rates within practical filter dimensions:** The famous "accordion-pleated" Micronic* filter element has up to ten times more filtering area than old-style filters—gives high flow rates in a minimum of space.

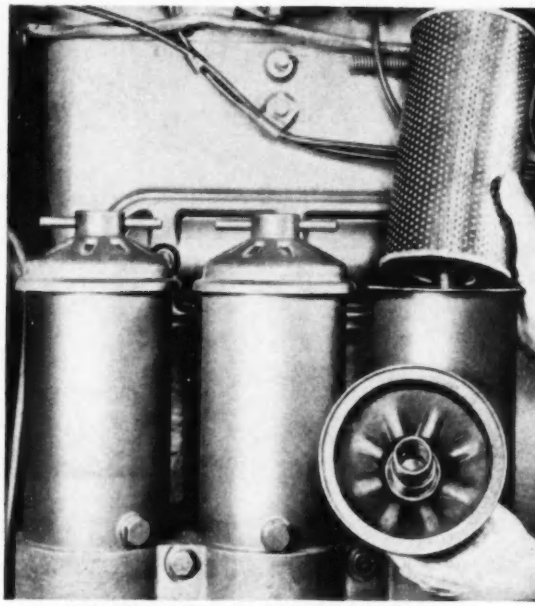
✓ **Ultra-micronic filtration:** High flow rates are, of course, meaningless unless effective filtration is maintained, too. Electron micrographs prove that the Purolator* Micronic filter stops particles down to *submicrons*—.0000039 in.!

✓ **Maximum dirt storage capacity:** The pleated design of the Micronic filter element provides many times more dirt storage space than old-style filters. This important advantage means uniform, efficient performance and a lengthy service life.

✓ **Minimum pressure drop:** The Purolator Micronic filter element introduces a remarkably small pressure drop in the lubricating system . . . permitting pumps of practical size and simple type.

✓ **Will not remove or absorb additives:** With Purolator Micronic filtration, you keep *all* the oil quality you pay for. The Micronic filter element will not strip additives . . . an important advantage with modern HD and heat-resistant oils.

*Reg. U. S. Pat. Off.



Purolator Micronic Filters in a typical Diesel full-flow installation. Although the Purolator Micronic filter elements measure only 4½ in. by 9 in., each one filters 9 gallons of oil per minute, giving a total of 27 g.p.m. for the complete filter unit.

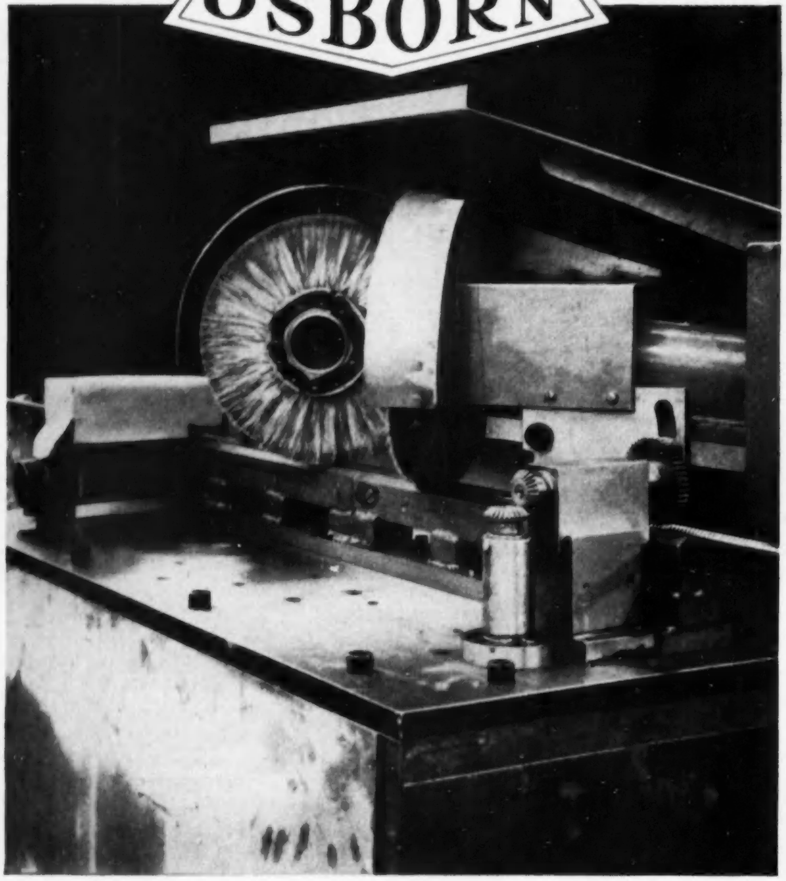
The advantages of Purolator Full-Flow Micronic filtration—wherein *all* the oil is filtered *each time* it passes through the engine—have been dramatically demonstrated during the past few years. In some instances engine life has been increased by thousands of hours, bearing and ring wear has been reduced to almost imperceptible minimums, and engines have been made to operate efficiently where air-borne abrasives formerly destroyed them in a matter of hours. One after the other, leading makers of Diesel and gasoline engines and vehicles are adopting full-flow lubrication . . . and standardizing on Purolator Full-Flow Micronic filters. In some fields, manufacturers are finding that full-flow lubrication is becoming a necessary feature to maintain a competitive sales position.

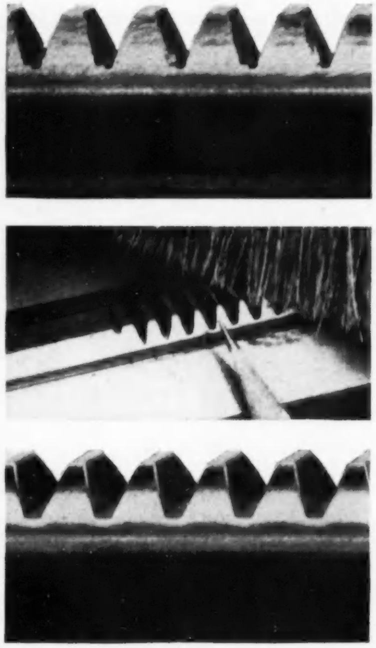
Time and again, in impartial tests conducted by vehicle and engine manufacturers themselves, Purolator Micronic filters have been proved best on all counts . . . fineness of filtration, long service life, ease of servicing.

Our Engineering Department will gladly co-operate in helping you prove—*in your own way, on your own equipment*—that there is no finer filter made than Purolator. Simply write, describing your equipment and filter requirements.

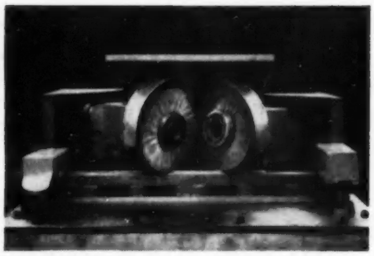
PUROLATOR PRODUCTS, INC.
Rahway, New Jersey, and Toronto, Ontario, Canada
Factory Branch Offices: Chicago, Detroit, Los Angeles

PUROLATOR
MICRONIC OIL FILTER
"FIRST IN THE FIELD OF FILTERING"





BEFORE AND AFTER. Top view shows closeup of rack teeth with light burrs and rough surface before brushing by new "push-button" method. Center view shows closeup of rack in machine after completion of brushing. Bottom view shows teeth after brushing. Note uniform surfaces and smooth finish on all teeth.



HOW IT'S DONE. Two rotating Osborn power brushes, engage rack teeth at angles as shown. At push of button, rack drives through machine at about 5 ft. per minute. When the rack completes passage, the drive reverses and sends it back in the other direction. On return travel of part, the direction of brush rotation is reversed to contact surfaces on the opposite side of rack. This gives both sides of teeth uniform brushing.

Formerly 50 minutes...

Now brush-deburred in 6 minutes

8 times as fast . . . more uniform deburring . . . finer surface finish. These are the advantages gained by a large machinery manufacturer with an automatic power-brushing method. The part: a rack gear, 17 ft. long with more than 1000 teeth. The job: light deburring of machine-cut teeth, and blending the junctures of intersecting surfaces to form smooth curves in place of fragile, sharp edges.

With the help of their **O**sborn **B**rushing **A**nalyst, they devised the machine shown above. This automatically controlled machine with two heads of Osborn Fascut® brushes does the entire job in 6 minutes. Burr removal and surface juncture blend are far superior to former methods.

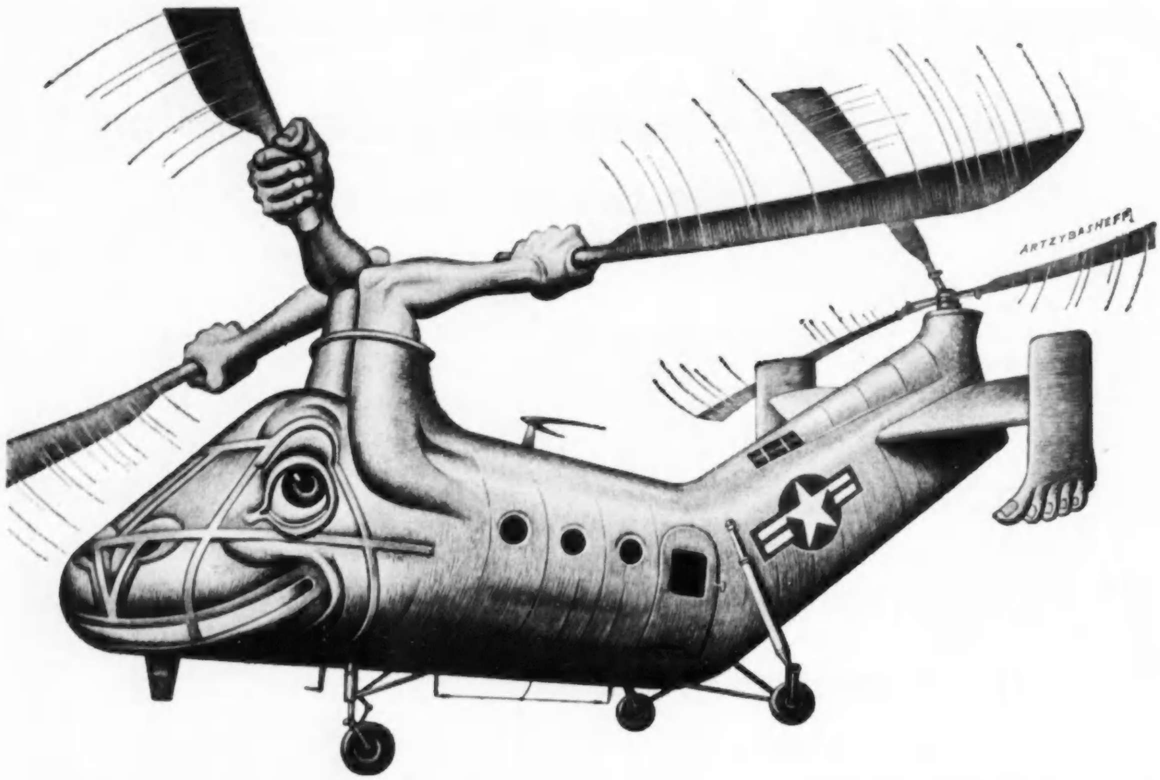
This is typical of thousands of cases where production is being vastly improved with Osborn power brushing methods. Find out how you can cut *your* costs! Call in your **OBA** today or write *The Osborn Manufacturing Company, Dept. S-2, 5401 Hamilton Avenue, Cleveland 14, Ohio.*

Osborn Brushes

OSBORN POWER, MAINTENANCE AND PAINT BRUSHES AND FOUNDRY MOLDING MACHINES

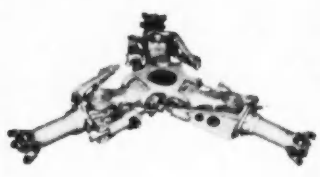
WHAT'S YOUR PROBLEM? The nearby Osborn Brushing Analyst is experienced in working with machine designers and methods engineers to solve problems with the latest power brushing techniques. Feel free to call him for help!


What's New at AiResearch
GENERATOR
115/200
Smallest,
most compact
AC generator
ever built!
Actual Size



How a helicopter hangs by its "elbows"

For flexible "elbows" —rotor assemblies that control the maneuvers of its H-21 Helicopter—Piasecki looks to Lycoming's precision production



Straight up, straight down, forwards, backwards, or just hovering—the Piasecki "Work Horse" Helicopter's peculiar flying maneuverability rests in its rotor assemblies. It is these flexible "elbows" that adjust the pitch of the 'copter's great blades. Each unit involves more than 625 separate parts. To machine and assemble them, Piasecki depends on Lycoming for precision production.

Lycoming stands ready to assist you whether you have a metal product that needs speedy precision or volume fabrication—or "just an idea" in the rough or blueprint stage. Long famous for its metal-working skill, Lycoming continues to meet the most exacting requirements in a wide diversity of fields, both industrial and military. *Whatever* your problem—look to Lycoming!

More than 6,000 machine tools, a wealth of creative engineering ability and 2½ million feet of floor space stand ready to serve your needs.

AIR-COOLED ENGINES FOR AIRCRAFT AND INDUSTRIAL USES • PRECISION-AND-VOLUME MACHINE PARTS • GRAY-IRON CASTINGS • STEEL-PLATE FABRICATION

LOOK TO LYCOMING FOR RESEARCH FOR PRECISION PRODUCTION

AVCO MANUFACTURING CORPORATION

LYCOMING-SPENCER DIVISION — WILLIAMSPORT, PA.
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Lycoming-Spencer Division
AVCO Manufacturing Corp.
652 Oliver Street
Williamsport, Pa.

Please send me further information on Lycoming's varied abilities and facilities.

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United Specialties Dual Unit

means maximum clean air protection

For complete air cleaner protection under extreme dust conditions, United Specialties Company provides a two-way safeguard — a combination oil bath air cleaner and pre-cleaner.

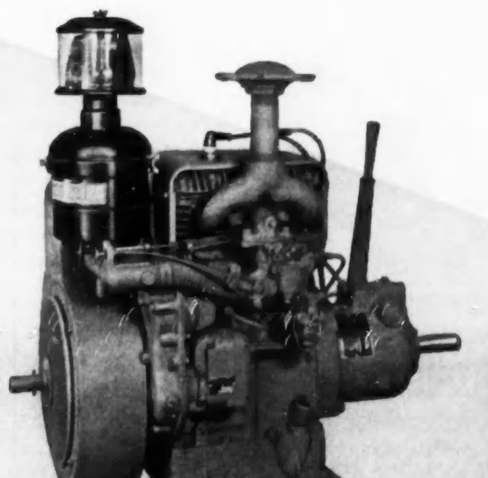
The pre-cleaner removes a large percentage of dust before it can get into the air cleaner. This prevents clogging, permits air cleaner to operate efficiently for longer periods, saves air cleaner oil changes — provides extra engine protection. After air is processed through the pre-cleaner, the efficient United Oil Bath Air Cleaner goes to work on remaining dust and other harmful abrasives. With this double action, only clean air comes in contact with precision-machined combustion chamber parts, thus greatly increasing engine life.

With over 15,000,000 air cleaners produced . . . with over 30 years of air cleaner building experience . . . with a wide variety of models available, United Specialties Company is best equipped to handle your specialized air cleaner and pre-cleaner requirements.

We invite your inquiry.

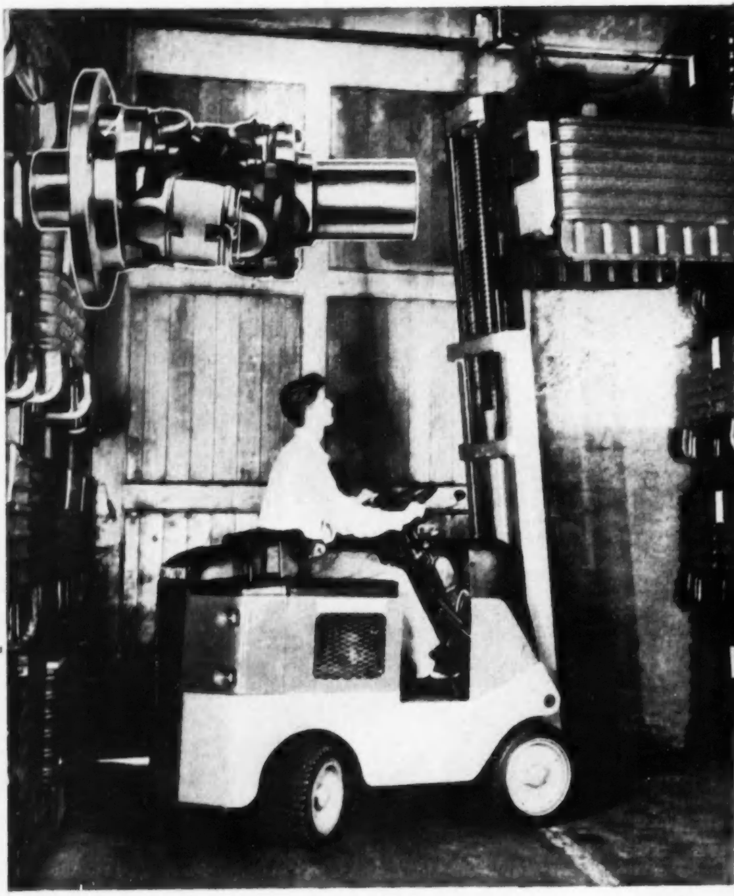
Wisconsin Engines Protected by UNITED

Wisconsin Motor Corporation, world's largest builder of heavy-duty air-cooled engines, is one of many well-known manufacturers who use United air cleaners as original equipment. Illustrated is the Model TF, Wisconsin air-cooled engine equipped with United Oil Bath Air Cleaner and United Pre-Cleaner.

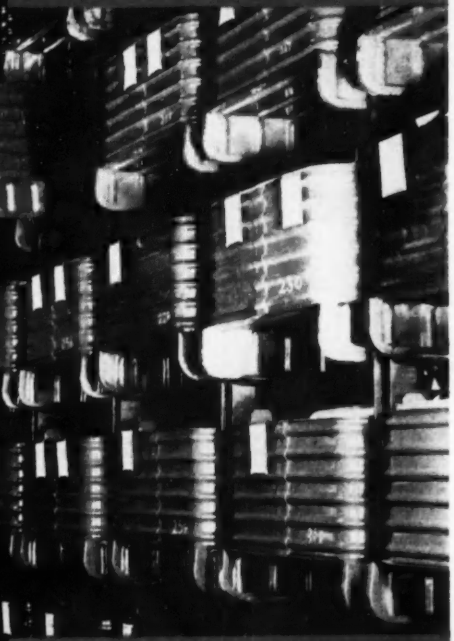


UNITED
SPECIALTIES COMPANY

United Air Cleaner Division — Chicago 28
Mitchell Division — Philadelphia 36
Birmingham 11, Alabama

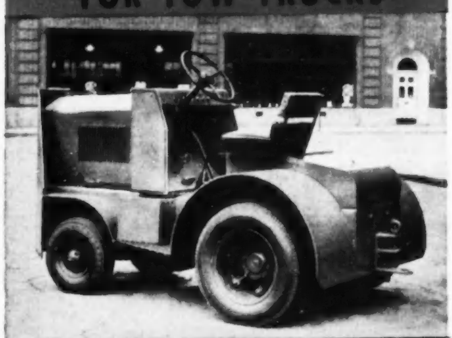


FOR LIFT TRUCKS

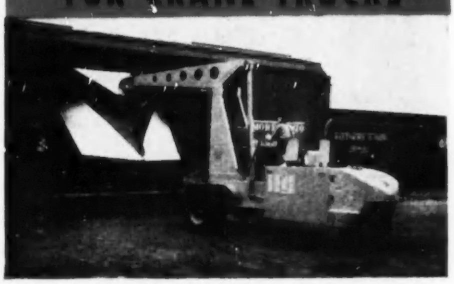


FOR STRADDLE TRUCKS

FOR TOW TRUCKS



FOR CRANE TRUCKS



Transmit More Power—In Less Space—At Greater Angles

MECHANICS Roller Bearing UNIVERSAL JOINTS excell for both main drives and controls — in all kinds of material handling trucks. Have transmission flanges for any type of brake drum. Easy to service — MECHANICS Close-Coupled UNIVERSAL JOINTS transmit more power — in less space — at greater angles than any other joints. Let MECHANICS engineers help give *your* machines competitive advantages.

MECHANICS
UNIVERSAL JOINT
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MECHANICS
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UNIVERSAL JOINTS

For Cars • Trucks • Tractors • Farm Implements • Road Machinery • Aircraft • Tanks • Busses and Industrial Equipment

Perfected at Last!

Johnson

ALUMINUM-ON-STEEL SLEEVE BEARINGS

JOHNSON BRONZE PRODUCES ALL TYPES OF SLEEVE BEARINGS

- BRONZE-ON-STEEL
  copper lead
- STEEL BACK
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  babbitt lined
- CAST BRONZE
  plain or graphited
- SHEET BRONZE
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- ALUMINUM ALLOY
- LEDALOYL
  powder metallurgy

Are you one of the engineers who have been searching for a bearing metal with higher strength, higher load capacity and resistance to high engine temperatures? Improvements in machine design to reduce unit cost or improve efficiency often require greater loads on the bearings. Now you may design to use sleeve bearings with properties never available before.

These roll-bonded Aluminum-on-Steel Bearings may be used for loads up to 4000 P.S.I., yet have good conformability, good resistance to shaft wear, good resistance to corrosion, adequate seizure resistance and good resistance to fatigue. Tests prove that the bond to the steel back is as strong as the metal itself. These properties make Johnson Aluminum-on-Steel Bearings new high-load, high-speed bearings with a great future for high-load internal combustion engines. Write for full information.

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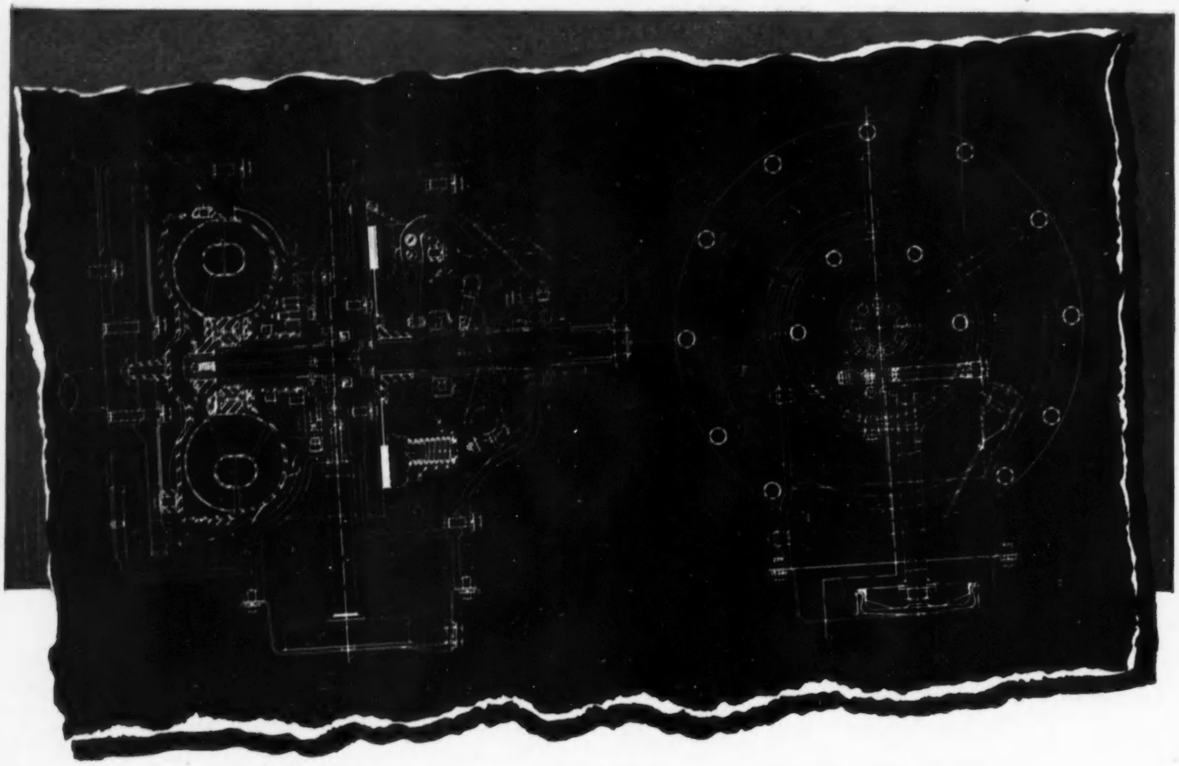
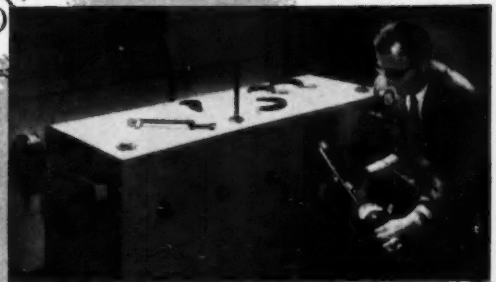
JOHNSON JB BEARINGS
Sleeve-Type

Sleeve Bearing Headquarters Since 1901



...FROM HELL TO THE NORTH POLE *and back again*



Checking the temperature of an aircraft test assembly in the High Temperature Chamber at 200° F.

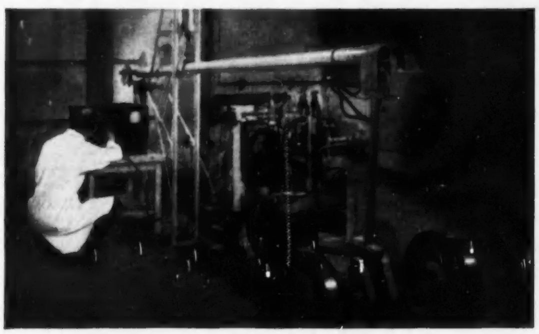
Heavy duty Rotator and Oscillator testing an aero-pneumatic swivel joint assembly used on the wing fold of a Navy dive-bomber.

Aero-hydraulic swivel joint assembly being taken from the Cold Chamber where it has been subjected to 75° below zero temperature for 168 hours.

CHIKSAN Hydraulic Swivel Joints tested in "Torture Chambers"

Despite the ever-increasing demands of Industry and the Armed Services, when it comes to setting rugged specifications Chiksan is its own harshest judge.

No Chiksan Hydraulic Ball Bearing Swivel Joint that can't pass the punishing tests of Chiksan "Torture Chambers" ever gets onto our loading platform, let alone actual use!



A pulse pressure generator where aircraft and ordnance hydraulic joints are subjected to shock pulses to 10,000 psi 240 times per minute.

There's an Arctic Chamber where the temperature drops to 75 degrees below zero to find out how metals, packings and working parts will react in most extreme cold. The Equatorial Box sends the thermometer soaring up to a sweltering 200 degrees to learn if Chiksan Joints can take it.

In the case of 3000 psi tests Hydraulic Joints are subjected to shock pressures from 0 to 4250 psi, 35 times a minute for 100,000 cycles. In testing special ordnance this rate has been stepped up to 240 times a minute at 0 to 10,000 psi. All test equipment has been designed and developed by Chiksan Engineers.

Every requirement of #MIL-J-5513 A is met—and in the case of Hydraulic Swivel Joints shipped for private use, standards are equally exacting.

No wonder Industry and Defense rely upon Chiksan to speed the flow of enterprise—to *keep* it flowing in a swift, reliable stream!

The Flow of Enterprise Relies on

CHIKSAN

Ball-Bearing Swivel Joints

Representatives in Principal Cities
Write for Catalog 2A, Dept. SJ-3

CHIKSAN COMPANY • BREA, CALIFORNIA • Chicago 28, Illinois • Newark 2, New Jersey

Well Equipment Mfg. Corp. (Division), Houston 1, Texas • Chiksan Export Company (Subsidiary), Brea, California • Newark 2, N. J.

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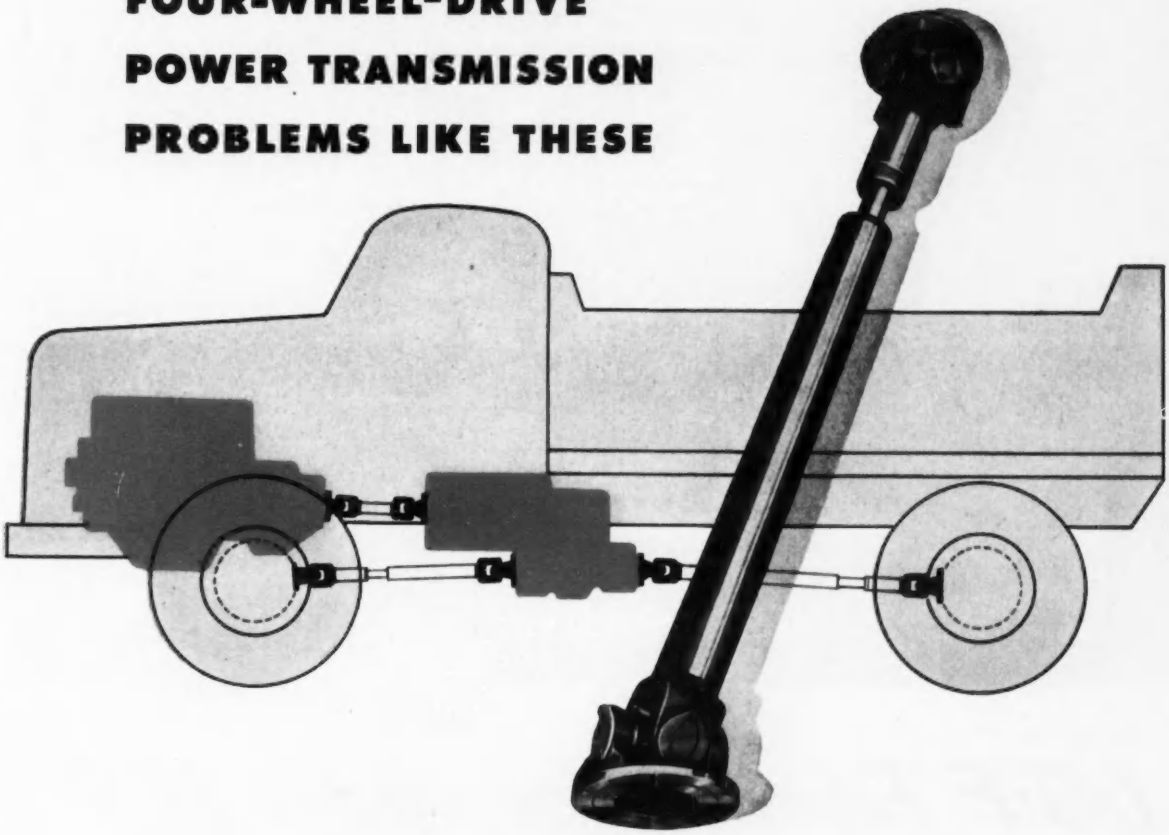
HERCULES

Our Engine Bearings are specified as original equipment by the leading names in motordom because they have consistently contributed to better performance for more than a quarter century.

DETROIT ALUMINUM & BRASS CORPORATION

DETROIT 11, MICHIGAN

FOUR-WHEEL-DRIVE
POWER TRANSMISSION
PROBLEMS LIKE THESE



SOLVED for SURE

with BLOOD BROTHERS propeller shafts

To get tremendous traction, the engineer (or truck owner) turns to four-wheel drive. Naturally, he expects efficient truck performance — and utter dependability from each universal joint. With a more complex power path, it's essential that all joints deliver maximum torque — with minimum friction and vibration.

It is significant that Blood Brothers Universal Joints have long been specified for just such tough applications. May we send you further details?

BLOOD BROTHERS machine co. ALLEGAN, MICHIGAN
UNIVERSAL JOINTS AND DRIVE LINE ASSEMBLIES

A Division of Standard Steel Spring Co. • Chicago Office: 122 S. Michigan

L·O·F Fiber·Glass mutes H-F* engine sound to a murmur

Passengers thrill to the speed and power of modern cars, *and* enjoy quiet, comfortable interiors . . . made possible by the excellent sound reduction properties of L·O·F Super·Fine Fiber Glass installed throughout the car.

Outstanding thermal and sound-insulating properties of L·O·F Super·Fine Fiber·Glass make it ideal for use throughout the car. It is used for roof liners, on fire walls, under package trays and as dash liners. And the L·O·F Hoodliner installed under the hood reduces air-borne noise.

L·O·F Fiber·Glass is lightweight, flexible and easy to install. The fine glass fibers will not rot, burn or absorb moisture. Libbey·Owens·Ford's long experience in glassmaking assures you of top-quality Super·Fine Fiber·Glass supplied to meet your schedules *right on time.*

For more information, call L·O·F's Detroit office, 610 Fisher Building, Trinity 5-0080. Or write Libbey·Owens·Ford, Dept. F.G 633, Wayne Building, Toledo 3, Ohio. Names of suppliers of Hoodliner Kits sent upon request.

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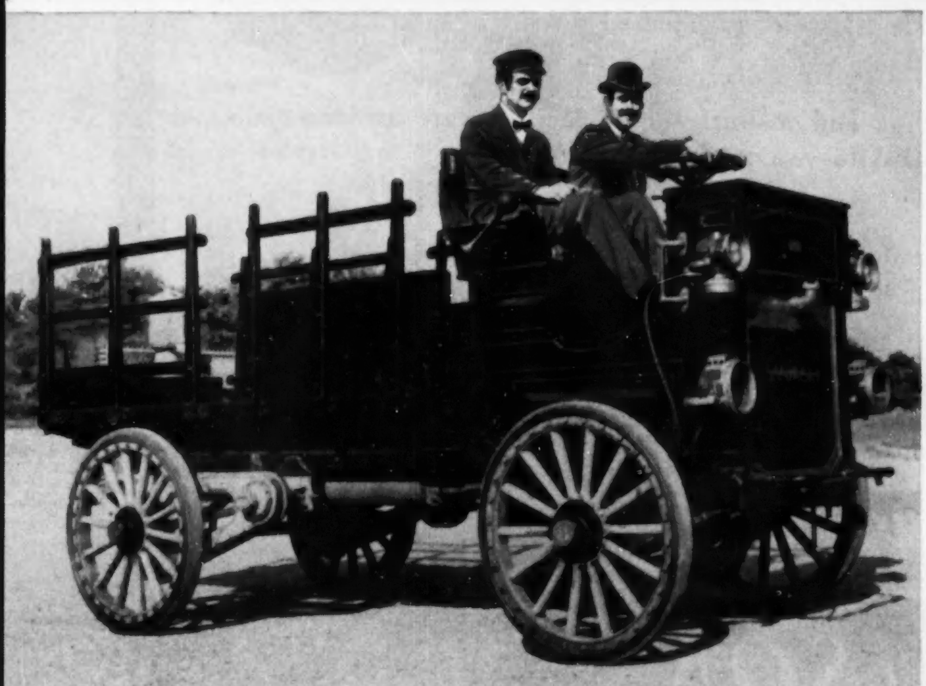
LIBBEY·OWENS·FORD GLASS COMPANY
FIBER-GLASS DIVISION

FIBER·GLASS

We'll be glad to show you why

M=TC

Morse *means* Timing Chains



(From the Bettmann Archive)

Heavy-duty, chain-driven truck made by Sandusky Motor Company. Date of truck is about 1910—twenty-one years after Morse first produced chains for industry.

Need long-lived, trouble-free timing chain drives?

Need skilled engineering help?

Come to Morse.

In producing over 58,000,000 timing chains for use on autos, trucks, and buses, we've also produced a reputation for the finest timing chains money can buy.

At the same time, we've built up an unequalled fund of engineering knowledge, which we'll be only too glad to put to work for you.

Whatever your needs, we'll be able to supply you with products and services that will show you why M=TC; Morse *means* Timing Chains to the automotive industry.

Send for free print

This is one of a series of old automobile prints that will appear in future Morse advertisements. Write for your free, enlarged copy, suitable for framing for your collection.

MORSE

MECHANICAL POWER TRANSMISSION PRODUCTS

PRODUCTS OF BW

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If it's a question of cooling, Harrison has the answer

When Harrison engineers are given an assignment involving heat transfer, they attack it from every angle.

Heat rejection, air flow, and coolant circulation through the radiator are thoroughly investigated, and the results carefully analyzed.

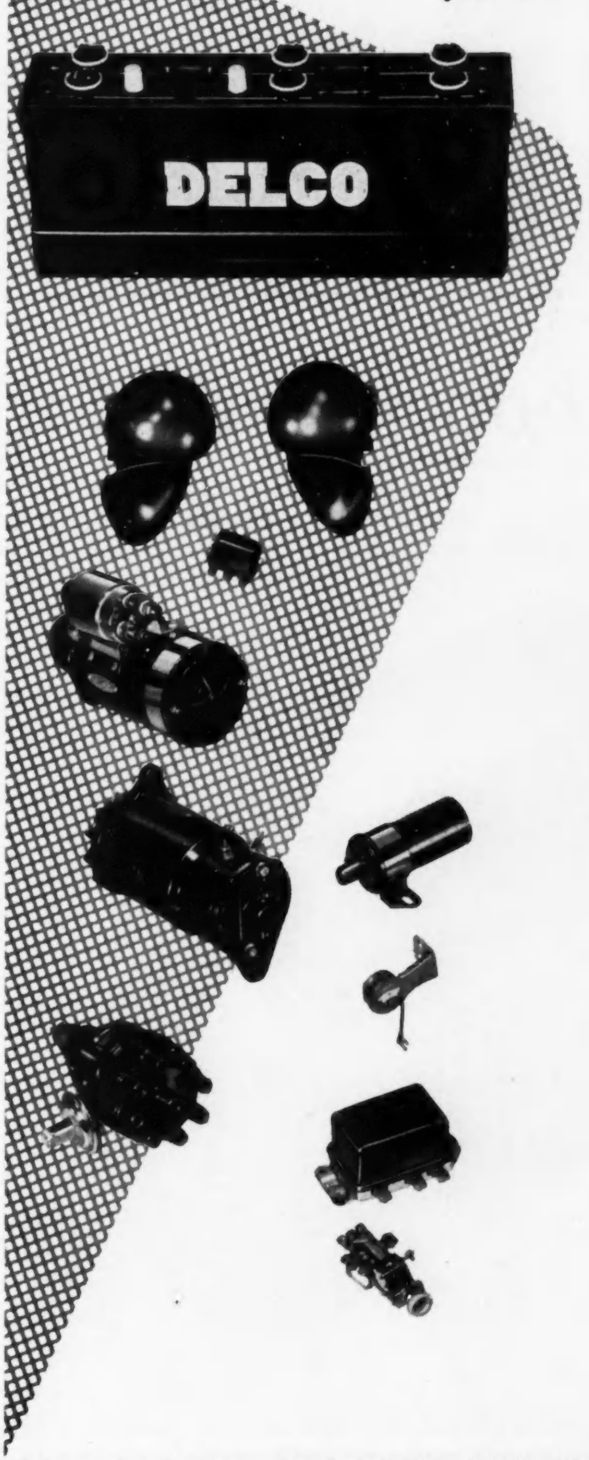
Finally, before recommendations are submitted, the entire cooling system is subjected to tests that simulate the severest operating conditions.

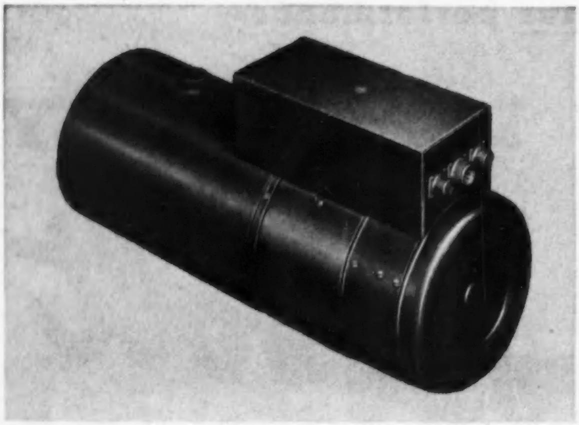
The result is a radiator engineered to do a specific job and do it well.

Our engineering and manufacturing facilities are at your disposal. We invite you to make use of them.

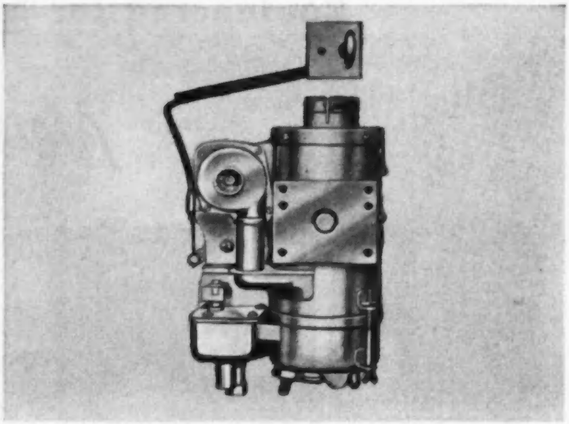
HARRISON RADIATOR DIVISION
GENERAL MOTORS CORPORATION
LOCKPORT, NEW YORK

HARRISON


DELCO

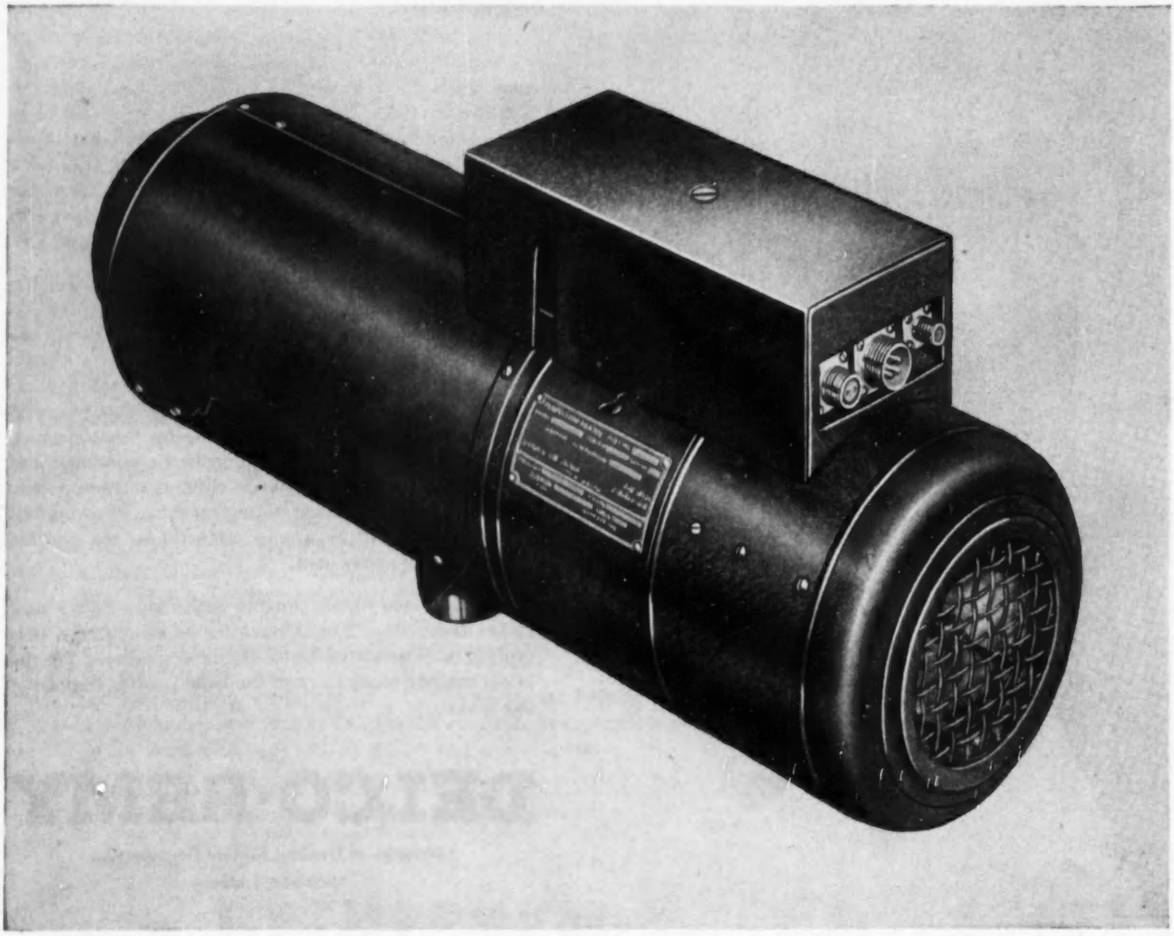


Model E-511 Coolant Heater for liquid-cooled gasoline and diesel engines. Delivers 60,000 B.t.u. per hour.

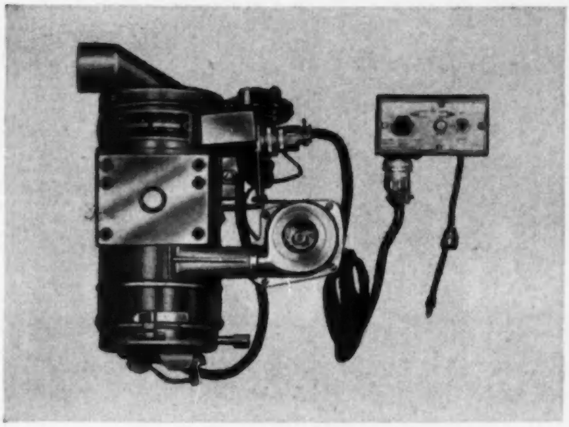


Series 460 Coolant and Direct-Fired Engine Heater. Each heater is a complete package requiring only electric, fuel, coolant and exhaust connections.

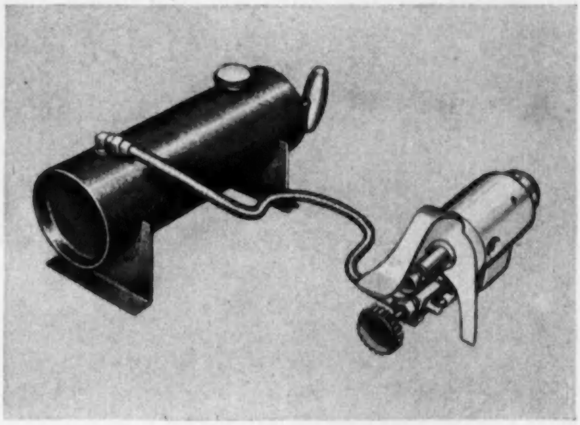
Everything anybody needs for



New! Perfection Fresh-Air Heater for Gasoline or Diesel Engines. Delivers more actual fresh-air heat than any other heater of this type. Four models. Fresh-air output from 20,000 B.t.u./Hr. to 90,000 B.t.u./Hr.



Series 590 Coolant and Direct-Fired Engine Heater. Independent mounting of fuel pump and control valve provides maximum flexibility of installation.



"Super-Jet" Blow Torch. Starts and performs efficiently even at 70 degrees below. Easily portable. Giant heat output of 75,000 B.t.u./Hr.

personnel, cargo, engine heating

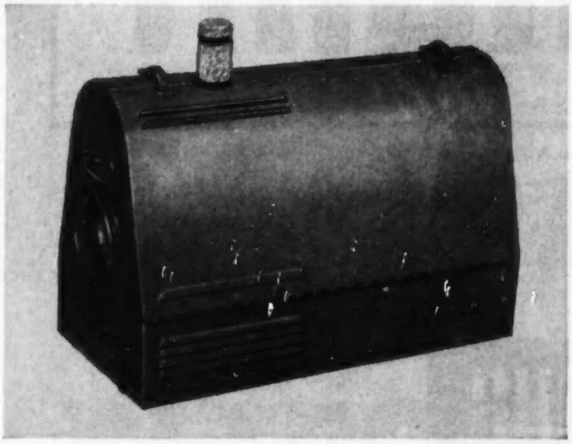
If you're building or putting equipment into service for operation in sub-zero or Arctic temperatures . . . call on Perfection. Our skilled staff of winterization experts knows more about combatting cold than the Eskimos. For more than 10 years, Perfection engineers have worked constantly developing and producing the finest and most complete line of heaters and winterization kits in the business. Now, whether your particular problem is personnel heating, engine pre-heating for starting or stand-by operation, space or cargo heating or heating for defrosting, Perfection can recommend and guarantee the equipment or system that's just *right* for *your* job. And there are no "bugs" in Perfection equipment because it is pre-tested to military specifications in our Arctic Laboratory. Write or wire for complete information.

PERFECTION STOVE COMPANY, 7391-B Platt Avenue, Cleveland 4, Ohio

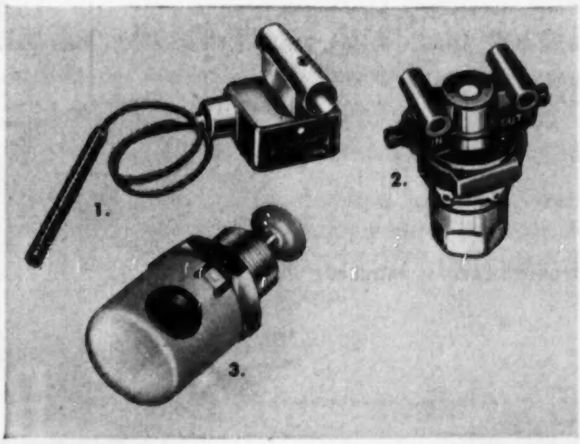
Perfection

headquarters for

Personnel Heating
Space or Cargo Heating
Engine Heating
Defrosting



Model E-600 Portable Heater. 60,000 B.t.u. fresh-air output. Meets the need for a *complete* heating unit that is easily portable.



Heater Accessories. Complete line of quality accessories including, (1) Overheat Control, (2) Fuel-line Filter, and (3) Oil Thermostat.


Boeing B-52

More cars and trucks are factory-equipped with FRAM FILTERS than any other make

Over 70 leading manufacturers of cars, trucks, buses, tractors and engines now specify Fram Filters for use on some or all of their products. This means that more than 20 million engines are protected by Fram Filters.

What better proof can there be that *Fram filters best* by actual test? Fram gets oil *cleaner*, cleans it *faster*, keeps it clean *longer* than any other popular make filter. And the many other Fram products—Air, Fuel and Water Filters and Crankcase Ventilators—are rapidly making the name *Fram* synonymous with *Complete Engine Protection.*

Fram's widespread manufacturing facilities offer you high-speed production and top-speed delivery. And the Manufacturers Sales Division, in Dexter, Michigan, is fully staffed to provide the automotive industry with fullest co-operation in meeting any and all types of filtration requirements. For full information, write, wire or phone FRAM CORPORATION, Providence 16, R. I. *Plants in:* Pawtucket, R. I.; Greenville, Ohio; Jacksonville, Fla.; Brigham City, Utah. *In Canada:* J. C. Adams Co., Ltd., Toronto, Ontario.

FRAM
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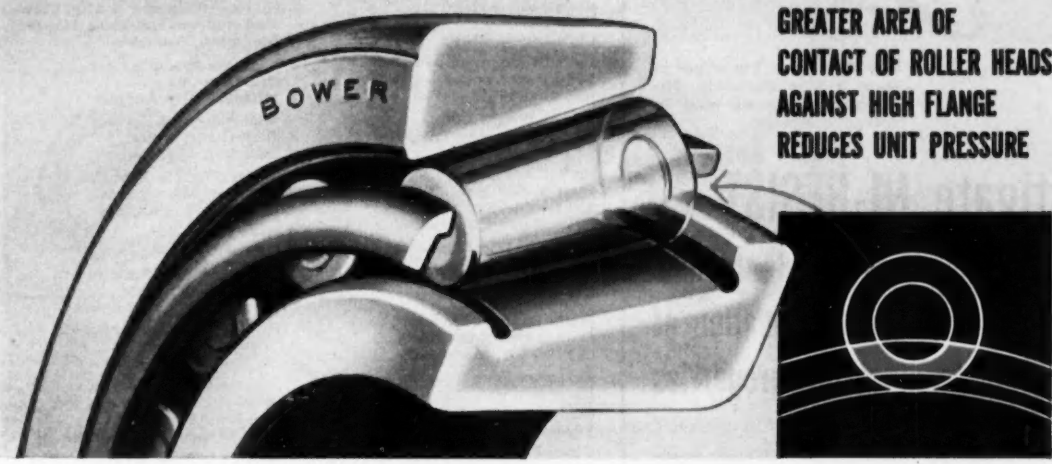
Bower spher-o-honed design increases bearing life



Bower engineers have incorporated many basic refinements into the design of Bower tapered roller bearings which cut maintenance to a bare minimum—increase efficiency. One of the most important of these is the *exclusive* feature illustrated above. Note that the flange at the large end of the cone is *higher*—providing a greater contact area for the roller heads. This greatly reduces wear, improves roller alignment and minimizes resultant "end play". Also note the larger oil groove, providing positive lubrication to the roller heads.

Other important Bower features which increase bearing life and dependability are generated spherical roll-heads, and smooth, precision-honed races. And Bower bearings are known throughout industry for materials and workmanship of highest quality.

Whether your product is in full production or still in the planning stage, you'll be wise to call in a Bower engineer now. He'll show you a wide range of sizes and types to fit any application.

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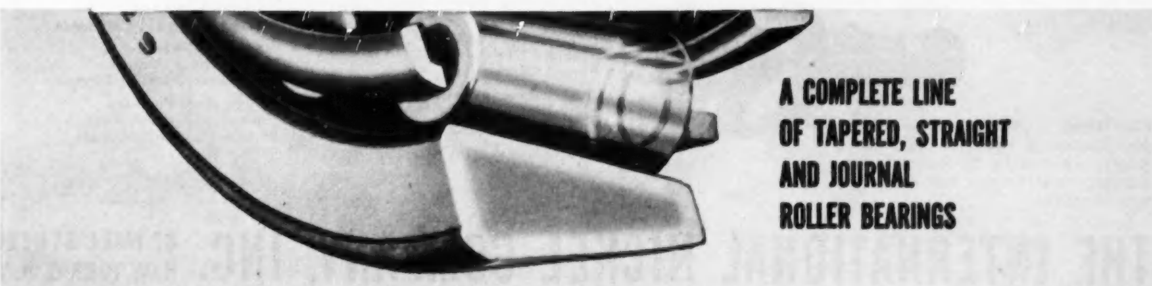

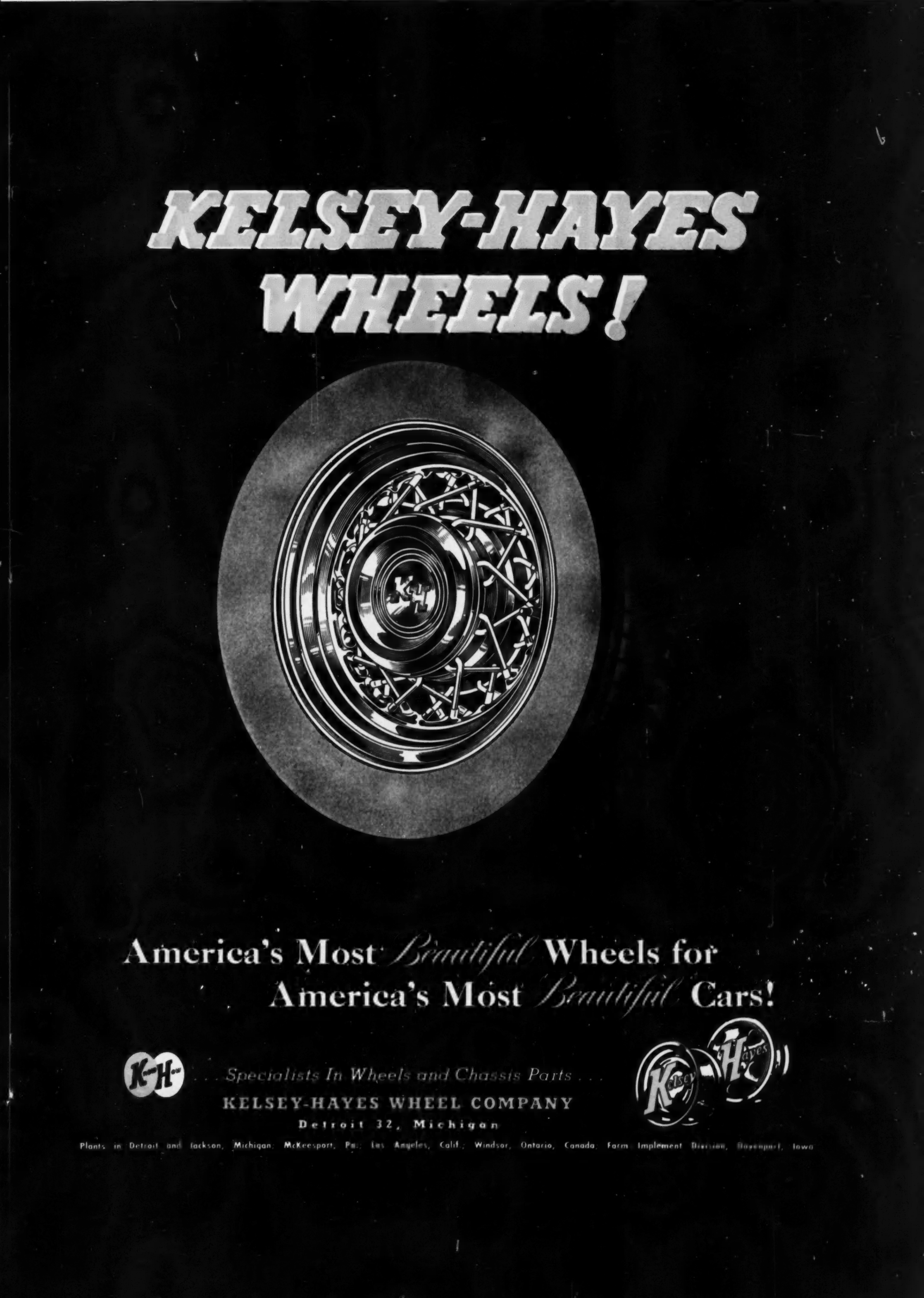

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